RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES
PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

VOL. 28 MAY, 1937 NO. 5

TECHNIC OF RADIUM TREATMENT OF CARCINOMA OF THE RECTUM[1]

By HARRY H. BOWING, M.D., *and* ROBERT E. FRICKE, M.D., *Rochester, Minn.*

From the Section on Therapeutic Radiology, The Mayo Clinic

THE technic of radium treatment of carcinoma of the rectum varies more widely than that employed for malignancy found elsewhere in the body. This is perfectly natural and comprehensible when one considers the special problems encountered and the peculiarities of rectal cancer as contrasted with cancer of other organs.

It is, of course, known that carcinoma of the rectum is insidious in onset, most patients consulting a physician about a year after the appearance of symptoms. While the majority of such cancers prove on microscopic examination to be of a low grade of malignancy, there is a marked tendency for them to metastasize to vital organs and the outcome in untreated cases is invariably fatal. A German authority recently studied a large series of untreated cases of rectal carcinoma and found that most patients survived only a year or two after the diagnosis was established; 90 per cent lived from one and a half to two years, 7 per cent lived three years, and only 1 per cent lived five years (1).

A majority of patients with rectal carcinoma are in the advanced age group and many have other chronic degenerative diseases. In such cases one is called on to treat an organ which must continue its daily function, and one must work in a heavily infected field which cannot be sterilized.

SURGICAL CONSIDERATIONS

Carcinoma of the rectum presents a major surgical problem, and the radiologist must co-operate closely with the surgeon as well as with the proctologist. Careful study of each individual patient is necessary before a plan of treatment can be worked out. In well selected cases in which lesions are operable—and decision as to operability requires much study—pre-operative radium treatment offers a great deal (2). In cases of inoperable lesions, radium therapy secures palliation and increased length of life in comfort to many patients whose condition otherwise is hopeless.

Operability.—Classification defining the lesion's extent or operability is a prerequisite to well planned therapy for malignancy anywhere in the body. In rectal carcinoma, however, many difficulties are presented. One must consider the size of the lesion, its location and accessibility, the general condition and age of the patient, the grade of malignancy of the tumor, the presence or absence of distant metastasis, and the degree of fixation. For instance, a small local growth in the case of a patient aged 77 years who has arteriosclerosis and myocardial changes would hardly be considered operable. Nor would a small movable lesion in the case of a patient in good

[1] Read before the Radiological Society of North America, at the Twenty-second Annual Meeting, at Cincinnati, Ohio, Nov. 30–Dec. 4, 1936.

general health which biopsy revealed to be of Grade 4 malignancy, because of the known tendency of lesions of a high grade of malignancy to metastasize widely and also to recur after excision.

In our series of 132 cases the result of the original classification with regard to operability is only partially shown in Table I. While from the table it would appear that 60 per cent of the 132 patients had inoperable lesions when first seen, in reality the true percentage of inoperable cases was more than that because the data in the table were secured from the primary examination of the patient, and 15 patients, or 11 per cent of the total, were first referred for radium therapy in 1934, with recurrences from previous operations. In two of these cases prior operation had been performed in 1931, in one case in 1932, in eight cases in 1933, and in four cases in 1934. Hence, since the lesions in these cases, being recurrences, were therefore inoperable, these 15 cases must be subtracted from the total in figuring the original operable and borderline groupings (Table I).

TABLE I.—LOCATION OF LESIONS AND INITIAL CLASSIFICATION AS TO OPERABILITY

			Operable		Borderline		Inoperable	
Location	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Anorectal	20	15	6	30	3	15	11	55
Low rectal	39	30	12	30	0		27	70
Mid-rectal	27	20	12	44	0		15	56
High rectal	26	20	4	15	4	15	18	70
Recto-sigmoidal	20	15	8	40	3	15	9	45
Total	132	100	42	32	10	8	80	60

The location or accessibility of the lesions is of great importance from the standpoint of radium treatment. In Table I it will be seen that 30 per cent of the total growths were in the anorectal and rectosigmoidal regions, being about evenly divided between the two. Growths in these two regions present difficulties in treatment. Anorectal lesions are exquisitely painful and tender to any manipulation. Many of these growths are squamous-cell epitheliomas. On radium treatment, these speedily undergo regression, affording marked palliation, but unfortunately metastasis to the inguinal lymph nodes is extremely common and the prognosis is, therefore, guarded. Rectosigmoidal tumors often extend upward, and since it is possible to treat only those growths which are visible through the endoscope, treatment is necessarily limited.

Biopsy.—Biopsy has for many years been routinely performed at the first proctoscopic examination whenever this has been possible. We feel that the information so obtained is most valuable and that the risk, if any, is small. A small fragment of tissue about the size of a grain of wheat is removed with a rongeur. In this series of cases biopsy was positive for malignancy in 125 cases, or 95 per cent of the total. Of the remaining seven cases, biopsy was not made in four (in one of these cases surface healing had occurred from recent radium treatment elsewhere). In the other three cases inflammatory tissue was reported; however, in all three of them the growth was obviously malignant clinically, and evidently representative tissue had not been selected for examination. In Table II it will be noted that 86 per cent of all positive biopsies revealed malignancy of Grades 1 and 2, and in only 14 per cent of

TABLE II.—RESULTS OF BIOPSY

Type of Cell	Grade of Malignancy			
	1	2	3	4
Adenocarcinoma	29	54	4	4
Adenocarcinoma in adenoma	8			
Papillary adenocarcinoma	8	6		
Colloid carcinoma			3	2
Squamous-cell epithelioma		2	4	
Fibrosarcoma		1		
Inflammatory tissue 3				
Biopsy not performed 4				
Total 7	45	63	11	6
	108 (86 per cent)		17 (14 per cent)	

the 125 cases was malignancy of Grades 3 and 4.

Colostomy.—The value of colostomy in cases of carcinoma of the rectum presents an interesting problem. In this series colostomy was not performed in 75 cases, or 57 per cent, but was performed in the remaining 57 cases, in four instances elsewhere. There is no question but that colostomy is necessary when marked obstruction is present and the general condition of the patient permits. Beside relieving obstruction, the operation allows exploration of the viscera for evidence of metastasis, affording very valuable information which may alter the whole plan of treatment. In addition, the field of treatment can be kept much cleaner after colostomy, and a larger dosage of radium can be employed because ensuing stricture will not be so disturbing.

Patients with rectal carcinoma, however, can be cured without colostomy, and palliation has been secured in many other cases. The technic of treatment has to be more delicate in such cases, and the dose of radium milder to reduce subsequent stricture. The patient must be given a low residue or non-residue diet during treatment, with mild cathartics and daily rectal irrigations. Many patients with extensive inoperable lesions, if no serious obstruction exists, can be treated by dietary measures and colostomy can be postponed for a year or longer.

TYPES OF RADIUM TREATMENT

The technic of radium treatment for the various types of rectal lesions is difficult to describe. Binkley, for example, has stressed the importance of implantation and of teleradium. Careful summing up of the whole situation in each particular case, however, is a prerequisite to intelligent planning. The technic of radium treatment varies widely according to the purpose to be achieved. Methods fall into two general categories: (1) radical aggressive treatment intended to effect a possible cure, and (2) limited palliative treatment intended to relieve pain and to retard the progress of the growth when the lesion is inoperable. The former plan is, of course, attended with some risk.

Radical Aggressive Treatment.—In the first category is the careful insertion throughout the substance of the growth of needles containing radium element or gold radon seeds, employing sacral anesthesia; also, and with less risk, the precise application of two universal tubes, strapped together with adhesive to form a small plaque, inserted through the endoscope directly against the growth.

Radical or aggressive radium treatment is indicated in two classes of operable cases: (1) as a pre-operative measure, best given while the patient is convalescing from colostomy (three months after this series of treatments the patient should return for consideration of radical resection), and (2) in cases of small polypoid lesions of a low grade of malignancy. In such cases the growth may be destroyed entirely, without subsequent surgical treatment, by fulguration (5) using monoterminal current (which destroys tissue by desiccation) and radium.

Limited Palliative Treatment.—In the category of limited palliative treatment not engendering much risk is the application of radium packs at a distance. Single tubes heavily filtered with lead and rubber are placed through the proctoscope in the center of annular growths, and two or three universal tubes arranged in tandem in the center of a hard rubber applicator are inserted into the rectum for the treatment of anorectal or low rectal neoplasms. Vaginal applications are employed for women, using the vaginal portal as an additional focus for irradiation.

TECHNIC

Our technic of radium treatment at the Clinic has been undergoing modifications from time to time. In order to analyze the most recent methods, we have checked the records of all patients with carcinoma of the rectum who were for the first time referred for radium treatment to the Section on Therapeutic Radiology of The Mayo Clinic during 1934. Patients who returned during the year but who had pre-

viously been treated with radium were not included. This is in no sense, however, a study of results, the results of radium treatment having previously been published (3). As has been mentioned previously, there were 132 patients in all, 78 (or 59 per cent) being males, and 54 (or 41 per cent) being females. The youngest patient was 28 years of age, the oldest 86; the average age was 58; 75 per cent of the patients were more than fifty years of age.

Radical or Aggressive Radium Treatment: Implantation.—Gold radon seeds containing from 1 to 2 millicuries each, or needles containing 1 mg. of radium sulphate filtered through platinum, were used in 10 of our 132 cases. Surgical diathermy with biterminal current (which destroys tissue by coagulation) was employed in two of these cases to facilitate introduction of the needles and to minimize bleeding and the spread of infection. In two additional cases of recurrent carcinomatous masses, 5 mg. steel alloy needles were employed.

The technic of implantation consists, first, in careful preparation of the patient. A non-residue diet is necessary for several days if colostomy has not been performed. The rectum is carefully and thoroughly cleansed with soap and water enemas. Sacral block anesthesia is employed and a kidney rest position is used. The lesion is exposed with a proctoscope, and the field is carefully washed and cleansed with green soap and water and antiseptic solution. The needles or seeds are then distributed as evenly as possible, an effort being made to irradiate each cubic centimeter of tissue.

Contact Treatment.—Contact treatment consists in the application of two universal tubes, containing equal amounts of radon or radium sulphate, strapped together side by side to form a small plaque. The two brass tubes are covered with rubber to avoid the effects of secondary irradiation. Long strings are then attached to this two-tube plaque. The patient, following rectal cleansing enemas and a hypodermic of "H.M.C. No. 2" or one-sixth grain (0.01 gm.) of morphine sulphate to relax the parts, is placed on the proctoscopic table and the lesion is visualized by endoscopic methods. The lesion is then cleansed with an antiseptic solution and the plaque is placed directly against the lesion. It is held in place by a liberal packing of gauze moistened with antiseptic; the packing is used distal and proximal to the radium plaque and displaces the opposite rectal wall. The dosage employed varies from 40 to 100 millicurie- or milligram-hours per square centimeter of malignant tissue surface covered by the plaque. The variation is determined by the extent of infiltration and the amount of packing which can be inserted to protect the opposite wall as well as by the size of the lumen and the presence of a colonic stoma, and so forth.

The patient rests quietly in bed after the plaque is in position, usually sleeping under the influence of the hypodermic medication. The area covered by the plaque measures about 2.5 by 1.5 cm., daily doses being continued until the entire surface of the lesion has been treated. The objection may be raised that radium tubes so applied will not remain in place. Very careful packing of gauze beyond and below the plaque, however, should retain it in position. When patients return after three months, examination reveals that changes in tissue due to treatment are well confined to the area of malignancy. We would like to emphasize the fact that this contact treatment demands as much care and concentration as interstitial treatment. The proctoscopes and metal packers employed are marked in centimeters to record the exact position of each application.

Contact treatment was employed in 89 of our 132 cases; in 27 cases treatment followed destruction of the growth by electrothermic methods. We have found it expedient to begin treatment at the time of fulguration—immediate treatment tends to prevent post-fulguration hemorrhage as well as to destroy residual cancer cells.

These various types of radical aggressive treatment, of course, entail some risk. The treatment planned had to be abandoned because of complications in only five

instances, and there were no hospital deaths in this group of cases.

Limited or Palliative Radium Treatment.—Limited or conservative treatment in the main entails very little or no risk. It was used in the majority of our cases for advanced inoperable lesions. In our series of 132 cases there was clinical evidence of metastasis to the liver in 13 cases, and metastasis was proved at colostomy or exploratory operation in nine of these cases. Metastasis to the lungs was present in four cases, and to the ribs in one. Metastatic supraclavicular nodes were found in one case. Metastasis to the aortic lymph nodes was found in one case, to the omentum in another, and to the mesentery in a third case, all proved at operation. In two cases the growth had perforated to the bladder, and in two other cases to the peritoneum.

Metastasis to the inguinal lymph nodes is very common, especially with cancers of the lower part of the rectum. These nodes were enlarged and shotty and suspicious of metastasis in 68 cases. For all of these desperately ill individuals only limited treatment, of course, could be advised.

Treatment of the 15 patients with recurrent carcinomatous lesions was for the most part palliative; in only two cases were radium needles inserted into the recurrent growth. In eight of these cases teleradium was employed; in the remaining five, radium tubes. It is interesting to note in this connection that a third of these recurrent lesions were of a high grade of malignancy (Grades 3 and 4). This is in contrast to 14 per cent which represents the percentage of lesions of these grades of malignancy in the series as a whole. The high mortality in cases of recurrence of rectal carcinoma is illustrated by the fact that only three of these 15 patients (20 per cent) were living two years after treatment for the recurrence, and only one of these patients appears to be free of the disease.

External Irradiation.—Thirteen of the patients in the series received this form of treatment, which consisted of 200 mg. of radium filtered through lead at a distance of 5 cm. over several portals. Eighteen patients received high voltage roentgen therapy, seven having received such treatment elsewhere. The inguinal regions were externally irradiated by radium blocks in 68 cases; in the case of low rectal lesions the groins were treated almost routinely, especially when the nodes were enlarged and firm, or prominent in one groin and not the other. The groins were checker-boarded into areas 4 cm. square; 50 mg. of radium was then used, filtered with 2 mm. of lead at a distance of one inch (2.5 cm.) over each area. Four areas were treated at a time and an erythema dose was employed.

Central Irradiation.—Forty-two patients with annular lesions were treated by central irradiation. One tube, with or without additional lead and rubber as a filter, was placed in the center of the involved intestinal lumen. A field corresponding to the length of the tube was treated daily. Lead was used as a filter when lesions were thick or much superficial necrosis existed. Dosages ranged from 300 to 700 millicurie-hours per application. The intention in such cases was to retard the growth and maintain a patent intestinal lumen.

Vaginal Irradiation.—Forty-one of the 54 female patients received vaginal radium treatments in addition to irradiation of the intestinal malignancy, itself; 2 mm. of lead and 1 cm. of rubber were used as a filter.

Other Forms of Irradiation.—Radium tubes consisting of 0.5 mm. of silver and 1 mm. of brass were used on a lead stem in four cases and inserted in malignant rectal sinuses, 300 to 400 millicurie-hours per field being employed. In 32 cases of anorectal or low rectal lesions, moderate irradiation was employed, using three tubes of 50 millicuries each in tandem in a hard rubber applicator. This treatment was used mainly for annular lesions, a total dosage of about 450 millicurie-hours being employed.

SUMMARY

Carcinoma of the rectum is a rapidly fatal disease attended by severe pain, bleeding, and intestinal obstruction. The

onset is insidious, and in most cases the condition is well advanced when patients are first seen. Surgery and radium therapy can co-operate in the cure of less extensive lesions and in other cases effect palliation.

A review of the 132 cases in this series of patients who were first referred for radium therapy at The Mayo Clinic during 1934 indicated that most of the patients were in the advanced age group, their average age being 58 years. Other degenerative diseases were present in many cases and the life expectancy was accordingly not high. In the majority of the cases the lesion was inoperable as a result of metastasis or of its extent and fixation.

Radical or aggressive radium therapy was employed in 12 cases and consisted of interstitial treatment with radon seeds or radium element needles, with or without the aid of surgical diathermy. This treatment was also used as a pre-operative measure, radical excision of the growth being carried out later. Contact treatment consisted of two tubes strapped together to form a plaque, which was maintained securely against the lesion by rectal packing. This treatment was employed in 89 cases. Daily treatments were given until the entire surface of the lesion was irradiated. Another method of attack in the case of small lesions was destruction of the growth by fulguration followed immediately by this contact method of treatment. Such patients should be re-examined every three months and further treatment given if necessary.

Conservative or limited treatment was applied in the remaining 31 cases in this series. In these, the lesion was advanced and inoperable, and palliation was all that was intended. The technic consisted of external irradiation with either radium at a distance or roentgen rays. Teleradium was employed over the lymph nodes of the groins: heavily filtered tubes were placed in the center of annular growths, and additional vaginal applications were employed for female patients.

CONCLUSIONS

Radium is a very flexible agent and treatment can be applied in a variety of ways. Each patient must be studied carefully and the intent of treatment definitely established; that is, whether cure is possible or only palliation can be expected. The technic differs for the two groups. In the smaller group showing possibility of cure, especially close co-operation with surgery is indicated. Colostomy is optional but very valuable.

The treatment of carcinoma of the rectum presents obstacles not encountered in dealing with malignant neoplasms of other organs. Treatment is necessarily tedious and involves extreme care and concentration. Patients cannot be treated hurriedly, nor can treatment be standardized. The reward of good results varies directly with the care and judgment exercised and with experience in treating this intractable condition.

REFERENCES

(1) Berlin Correspondence: Course of Untreated Carcinoma of the Rectum. Jour. Am. Med. Assn., Aug. 1, 1936, **107,** 366.

(2) Binkley, G. E.: Technic of Radiation Therapy and Colostomy in Rectal Cancer. Am. Jour. Surg., February, 1935, **27,** 231–236.

(3) Bowing, H. H., and Fricke, R. E.: Primary Rectal Carcinoma under Radiation Treatment: A Statistical Review of 500 Cases. Am. Jour. Roentgenol. and Rad. Ther., November, 1934, **32,** 635–645.

(4) Idem: Pre-operative Radium Treatment of Rectal Carcinoma. Am. Jour. Roentgenol. and Rad. Ther., December, 1935, **34,** 766–769.

(5) Krusen, F. H.: In Sajous' "Cyclopedia of Medicine: Electrosurgery." F. A. Davis Co., Philadelphia, 1934, **5,** 75.

PERORAL X-RADIATION IN THE TREATMENT OF INTRA-ORAL CANCER[1]

By HAYES E. MARTIN, M.D., F.A.C.S., *New York City*

Attending Surgeon, Memorial Hospital

THE protracted, fractional, or divided dose principle of radiation is now widely accepted as being preferable to the massive dose method in the treatment of malignant tumors in general. The favorable results obtained by this principle of radiation in pharyngeal growths logically suggest its use for those of the oral cavity proper. Experience has shown, however, that intra-oral tumors are generally more radioresistant than those of the pharynx, and that interstitial as well as external radiation is required for their control in most cases. We are of the opinion that these two methods of radiation (external and interstitial) may be combined to advantage in the treatment of practically all intra-oral cancer. In this combination of methods, the external radiation is given first in daily divided doses over a period of from two to three weeks, and is then followed immediately by the implantation of a small or moderate dose of radon seeds.

Adequate dosage by any method for large or radioresistant tumors of the oral cavity is commonly attended by certain untoward effects, both immediate and remote, in the adjacent normal tissues, and the technic described in this report is designed so as to lessen the incidence and severity of these untoward effects.

One of the main objections to the use of divided dose x-radiation in the treatment of cancer of the oral cavity proper is that, if the skin of the cheeks and/or submaxillary regions is used as the portal of entry, undesirable reactions are produced in the overlying or adjacent normal tissues. The nature and form of these undesirable reactions may be defined as follows: First, there are the immediate and temporary effects which consist of an acute radiation dermatitis in the skin and a radiation mucositis in the normal tissues of the cheeks, jaws, palate, or tongue. If these reactions are not confined to the local tumor area, but extend widely, they are highly objectionable, since not only do they increase the discomfort, but also sorely tax the

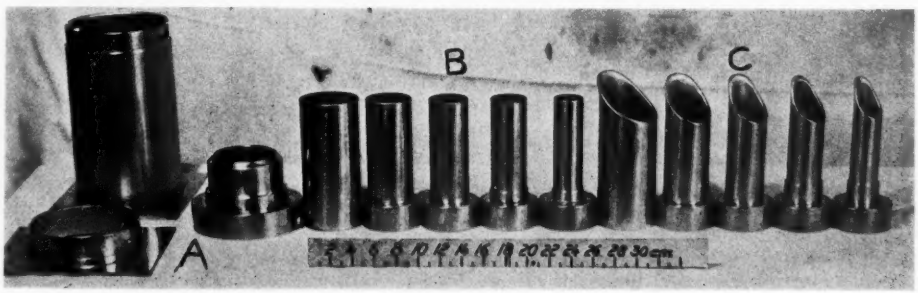


Fig. 1. Interchangeable cylinders for peroral x-radiation. By combination with the master cylinders (*A*) and the interchangeable cylinders (*B*), target-skin distances of either 35 cm. or 50 cm. may be obtained. Interchangeable cylinders of the regular shape (*B*) have diameters of 5, 4, 3.5, 3, and 2.5 cm., respectively, and are used when the direction of the beam is at right-angles to the tumor surface. A corresponding set of cylinders with oblique-shaped ends (*C*) are used when the tumor must be approached obliquely.

[1] Read at the Twenty-second Annual Meeting of the Radiological Society of North America in Cincinnati, Nov. 30–Dec. 4, 1936.

local and general tolerance. Secondly, there are the remote effects, such as late radionecrosis, osteomyelitis, or dental caries, which are due to diffuse degenerative changes in the soft tissues, the bones

Fig. 2-*A*

of the jaws and in the dental apparatus. Such complications, both immediate and remote, would undoubtedly be justifiable in an effort to cure an otherwise lethal disease if they were unavoidable, but we believe that they may be largely obviated by the technic which we shall describe in this report.

One of the best methods of prevention is to employ the open mouth as the portal of entry so that a narrow beam of x-radiation strikes the tumor area without first traversing an overlying layer of normal tissue. If this is impossible, one may so locate the skin portal and so direct the beam of radiation that while it may pass through normal tissues before reaching the tumor, it avoids those normal structures most easily injured (bone and dental structures), both proximal and distal, to the tumor area. It is with the first of these propositions that this discussion is concerned, that is, the elimination of the overlying or intervening layers of normal tissues by the use of the open mouth as the portal of entry in the external radiation of intra-oral tumors.

Fig. 2-*B*

By using the open mouth as the portal of entry for x-radiation, a growth of the tongue, tonsil, etc., may be converted into a surface tumor, so that it will receive the greatest intensity of any tissue in the incident beam of external radiation. The conversion of intra-oral tumors into surface lesions for purposes of external radiation makes them somewhat resemble skin tumors, whose relative ease of control by radiation depends in great part on their position at the surface.

Peroral x-radiation is applicable for growths of the following regions: the tongue, floor of mouth, jaws, mucosa of the cheeks, tonsils, hard and soft palate, maxillary antra, and posterior nasopharynx. The base of the tongue and that portion of the pharynx below it require external skin portals, since they cannot be approached directly through the open mouth.

TECHNIC

An essential factor in peroral x-radiation is the use of metal cylinders attached to the tube-holder which serve to separate the lips and jaws, to retract certain normal intra-oral structures in the approach to the tumor, to limit the beam of radiation

to the desired area and volume, and to insure its correct direction to the tumor. We have constructed such metal cylinders of brass tubing (lined with lead) in various sizes (2.5, 3, 3.5, and 4 cm. in diameter).

terior nasopharynx or antra, since these regions must be approached obliquely through the open mouth.

The patient may be placed in the dorsal recumbent position on a table and the tube-

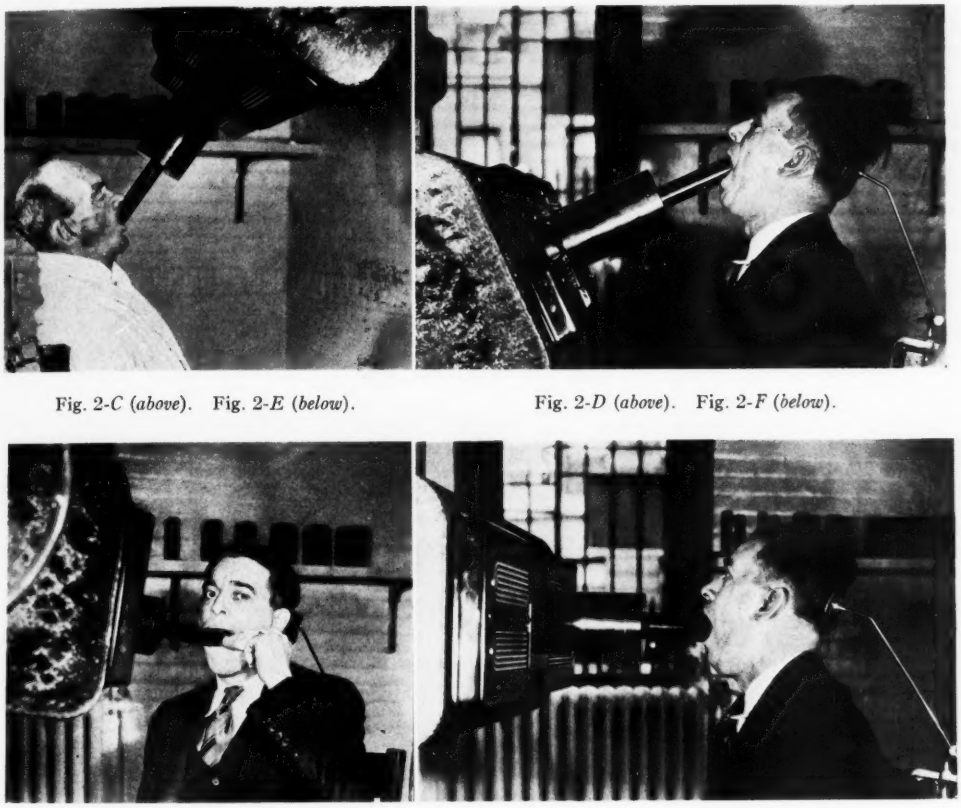


Fig. 2-*C* (*above*). Fig. 2-*E* (*below*). Fig. 2-*D* (*above*). Fig. 2-*F* (*below*).

Fig. 2. Peroral x-radiation with the patient *A* in a recumbent position and *B*, *C*, *D*, *E*, and *F* seated in a chair, the tube-holder tilted and adjusted. The position of the head is maintained by a head rest.

The jaws can seldom be separated to admit larger diameters than 4 cm. All of these fit into a master cylinder or cone so as to be readily interchangeable. The various shapes and sizes are illustrated in Figure 1. The regular shape (Fig. 1-*B*) is used for lesions of the cheeks, anterior portion of the tongue, floor of mouth, etc. Those with the tapered oblique-shaped ends (Fig. 1-*C*) are used for the tonsillar or palatal regions where the projecting edge may serve as a tongue depressor. The tapered end is also advantageous in irradiating the pos-

holder lowered so that the cylinder enters the mouth at the proper angle (Fig. 2-*A*). Although this method may be somewhat unwieldy, it has the advantage of stability once the proper set-up has been achieved. A more flexible technic is to place the patient in a sitting position before the tube-holder, which is then tilted, raised, or lowered, and the position of the patient's head adjusted until the desired set-up is obtained. The position of the head is maintained by an adjustable head rest attached to the chair (Figs. 2-*C*, 2-*D*, 2-*E*, 2-*F*).

We have treated a number of patients perorally with an x-ray tube structurally built in a fixed position with a fixed portal point-

In selecting cases for treatment by this technic, one should make certain that the growth is of suitable size and position to be

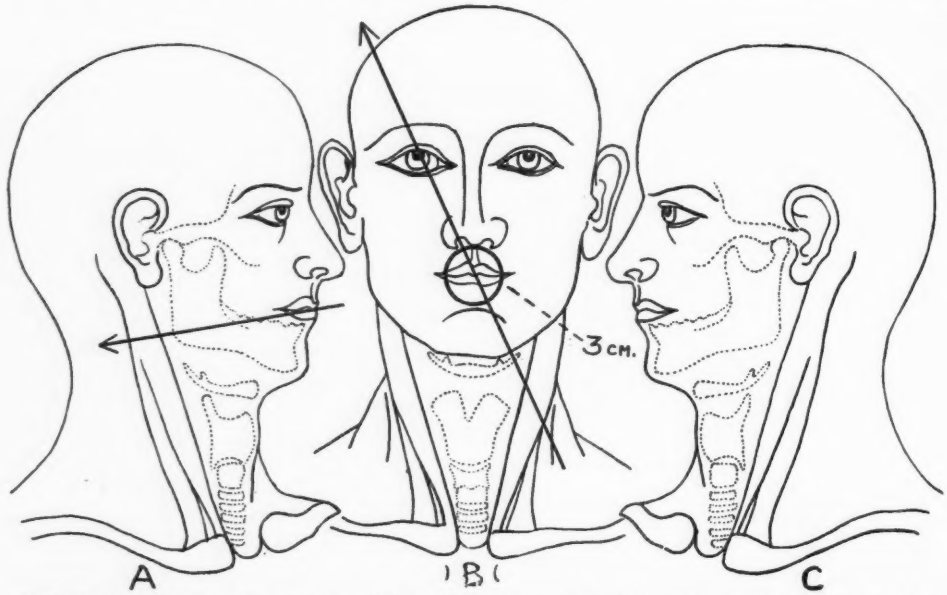


Fig. 3. A typical set-up for peroral x-radiation of carcinoma of the right tonsil. In *A* the direction of the beam in the horizontal plane is designated by the arrow pointing from the lips backward through the angle of the jaw. The vertical plane is designated in *B* by the arrow passing through the center of the mouth and pupil of the right eye. The circle over the mouth in *B* indicates that a 3 cm. peroral cylinder is to be used. Such a record of treatment factors insures a correct and uniform set-up for all treatments in a given case.

ing obliquely upward at an angle of 45 degrees from the horizontal level, but this form of apparatus is less flexible than the adjustable tube-holder.

For most cases, we have used x-rays at 200 kv., 30 ma., 65 cm. T.S.D. (target-skin distance), and 0.5 mm. Cu filter. Radiation of such penetration seems indicated in deeply infiltrating growths (2–3 cm.). For more superficial lesions we have, in a few instances, employed x-rays at 100 kv., 5 ma., 35 cm. T.S.D., and 1.0–3.0 mm. Al filter. Radiation of such moderate penetration appears to have certain advantages in superficial lesions (less than 1 cm. in depth). We have recently installed the apparatus illustrated in Figure 2 with the following factors: 200 kv., 8 ma., 35 and 50 cm. T.S.D., and 0.5 mm. Cu filter. In the future, we shall probably employ the 35 cm. T.S.D. for most superficial lesions treated perorally.

approached through the open mouth. The tumor should be of such size as to be reasonably well included within the beam of radiation (up to 3.5–4 cm.). Teeth in the upper and lower jaws anteriorly may have to be extracted in order to admit a cylinder of the necessary diameter. Inability to separate the jaws sufficiently to admit the peroral cylinder makes it impossible to employ this method.

We have constructed a series of sample cylinders which are kept on hand at the examining chair in the clinic where the treatment is outlined. The suitability in the individual case, and the exact factors of the technic are decided upon and recorded before the patient is taken to the x-ray treatment room, as is illustrated in a typical case in Figure 3. By inspection through the open end of the sample, the proper size of cylinder is selected and the exact direction of the beam in both the

horizontal and the vertical plane is decided upon. These factors are then recorded in relation to fixed anatomic drawn out of the mouth and positioned so that the growth may be made most directly accessible (Fig. 2-*E*).

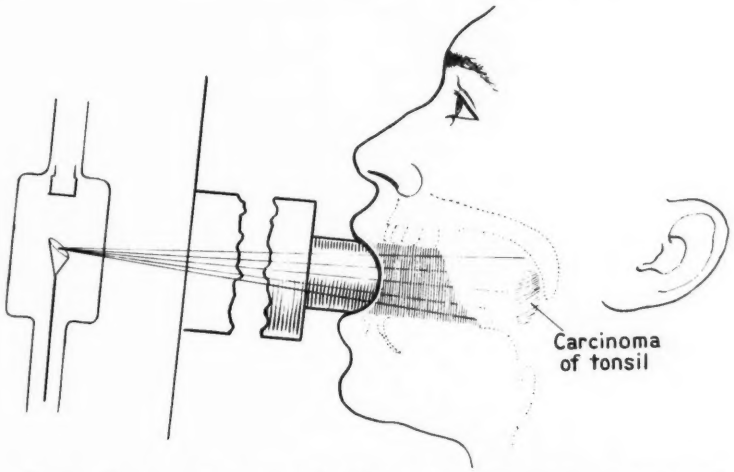


Fig. 4. Diagrammatic representation of peroral x-radiation in cancer of the tonsil.

structures, such as the angle of the jaw, inner or outer canthus, pupil of the eye, lobule, tragus, or other portions of the ear, etc. By such means, the correctness and uniformity of all subsequent set-ups are assured. This diagram should be used for reference at each subsequent treatment. From a lateral position, the horizontal level is observed and adjusted, and then standing behind the patient, the position of the patient's head is adjusted in relation to the direction of the beam in the vertical plane.

Each individual case will require its own modifications and adjustments. The set-up for a tonsillar lesion is shown diagrammatically in Figure 4. For lesions of the mucosa of the cheeks, the cylinder and direction of the beam are almost transverse (Fig. 2-*B*). For the anterior floor of the mouth or the anterior portion of the tongue, the beam is tilted obliquely downward and backward (Fig. 2-*C*). For the posterior nasopharynx, it is tilted upward (Fig. 2-*D*). In lesions of the lateral border of the tongue, the patient is directed to grasp the tip of the tongue with his fingers and by a combination of protrusion and traction to one side, the tongue is partly

DOSAGE

In the average case, the dosage is chosen with a view to the implantation of a supplementary dose of radon gold seeds, except in such locations as the posterior nasopharynx, where the peroral portal is combined with skin of the cheek portals or with a nasopharyngeal radium capsule.

The size of the total dose will depend on a number of factors, such as the size of the portal (cylinder), the position and histologic character of the growth, and the intended supplementary dose of seeds. In an average situation, such as a tumor 2.5 cm. in diameter on the lateral border of the tongue, we would use a cylinder 3 cm. in diameter, and apply a daily dose of from 200 to 250 r for 20 daily doses for a total of from 4,000 to 5,000 r, and immediately implant from 6 to 8 millicuries in seeds. For larger portals 4 cm. in diameter in the same location, the dose is reduced to from 150 to 200 r daily for a total of from 3,000 to 4,000 r in the same period. Smaller portals 2.5 cm. in diameter may be given from 350 to 400 r daily for totals of 6,000 r or more. The above mentioned doses are measured in air at the target-skin distance.

We have successfully employed several variations of technic, such as fractionated peroral x-ray treatment given every other day or even twice a week, if the patient lives at a distance from the clinic. In such instances, the individual doses are raised so as to bring up the total to the required level. In another variation, the total period of x-radiation may be cut down to ten days or two weeks with a corresponding decrease in the total dose of x-radiation and an increase in the dose of radon seeds. The possible number of such variations is unlimited and their indications and success will depend on the experience and ingenuity of the surgeon.

It often happens that the growth regresses so promptly and completely under the fractionated or protracted x-radiation that the supplementary radon seeds may be omitted, but in our opinion, there is so little contra-indication to or disadvantage in the insertion of a moderate supplementary dose of seeds that there is no particular merit in the attempt to accomplish the control of the growth by external radiation alone. Routine attempts to do so will be followed by an unnecessarily high percentage of failures and the unjustifiably severe effects of the large total doses of x-radiation alone.

Similar technics have probably been employed by others, and we make no claim to priority.[2] We have used such peroral portals since 1931,[3] when their advantages for tonsillar and soft palate growths occurred to us. Since that time, we have gradually extended their application until, at the present time, we find them of great advantage in most tumors of the oral cavity. By this means, the reaction from the x-radiation may be confined to the immediate area of the tumor, while the adjacent normal tissues, such as the jaws, teeth, palate, etc., may be almost completely protected. The disconcerting incidence of osteomyelitis or late radionecrosis is a common experience, especially in those growths which because of their bulk and radioresistance require large tissue doses of radiation. We believe that the incidence and extent of such complications may be greatly lessened by the judicious combination of several precautionary measures, such as the protection of the jaws and soft tissues from too diffuse radiation effects. The peroral portal is simply one of these precautionary measures, others of which are protective dental shields containing lead, the use of small and efficiently placed doses of interstitial radiation, the use of small, carefully centered portals for x-radiation, etc.

Since we have used these peroral portals, there has been a marked reduction in the incidence of osteomyelitis and late radionecrosis in our clinic. The progressive development in the technic of radiation therapy depends not only on the correct application of such broad general principles as fractionation or protraction of dosage, but on a careful attention to and the application of a number of smaller details. With this ideal in mind, the plan and execution of a radiation program becomes just as exact and as dependent on anatomic details as a surgical procedure.

These devices shown in Figure 1 were constructed in the machine shop at the Memorial Hospital by Mr. A. Schreiner and Mr. Kurt Bender, Master Mechanics, whose valuable suggestions as to design are hereby gratefully acknowledged.

[2] Brickner, in 1903, described the treatment by peroral x-radiation in a case of cancer of the cheek. He used a Ferguson vaginal speculum passed through a hole in a large sheet of lead and into the mouth in the desired direction. (International Jour. Surg., N. Y., 1903, **16**, 303–306.)

[3] Martin, H. E., and McNattin, R. F.: The Treatment of Cancer of the Pharynx, Tonsil, and Extrinsic Larynx by Divided Doses of External Radiation. Am. Jour. Roentgenol. and Rad. Ther., 1935, **32**, 717–729.

RADIATION THERAPY OF MALIGNANT LESIONS OF THE LIP[1]

By IRA I. KAPLAN, B.Sc., M.D., *New York City*

Director, Radiation Therapy Service, Bellevue Hospital

TREATMENT of the malignant lip is based upon the position, extent, and site of the lesion; whether or not it is ulcerated and infected; flat, indurated, and whether or not lymphatic glandular involvement is present.

Lymph node involvement is important because the location, type, and condition of the lymph drainage areas considerably influence the method of procedure for their control, along with treatment of the primary lesion. In our series[2] of 160 treated cases, 22 showed palpable lymph node involvement at the time of admission. The duration of the lesion before treatment determined in most instances the occurrence of lymph node invasion. Neck node involvement was uncommon in cases seen within the first six months from the onset of the local lesion.

The age of the patient is important; the younger the patient the more drastic being the treatment required to control the malignant process; in older patients with localized lesion surgery is often the method of choice and may readily eliminate the entire condition, and irradiation administered post-operatively prevents recurrence and metastases. The youngest patient treated was 21 years old and the oldest was 82 years old. In our series only six females were affected. Occasionally the presence of the lesion may be due to irritation by an irregular, rotten tooth, a poorly fitting denture, or to pipe smoking.

Thirty-four patients were persistent pipe-smokers; 35 were cigarette-smokers, and four were cigar-smokers. Two patients chewed tobacco; 85 smoked occasionally or not at all.

Elimination of the irritant agent is essential before any treatment is attempted. Mouth hygiene must be cared for before irradiation is employed in order to prevent local infection of the involved area and subsequent bone necrosis following radiation therapy, especially in cases in which tooth extraction is required.

The lesion on the lip may be a localized, scaly indurated, dry keratotic area, an ulceration, or a large bulky cauliflower-like growth involving the whole lip and part of the chin. Biopsy is advisable in all cases and is easily effected in the ulcerative type; in the keratotic localized lesion biopsy may at the same time remove the whole condition.

In most cases the lip lesion pathology was squamous-cell epithelioma. In most instances the lower lip is involved; occasionally, however, a malignancy of the upper lip is encountered.

Treatment of cancer of the lip is carried out either by surgery and irradiation or by irradiation alone.

In all cases, whether surgery or irradiation is employed, treatment begins with therapy to the neck gland area draining the lip lesion, followed by local treatment of the lip. Treatment of the neck glandular areas may be with high voltage x-ray or radium therapy. When the former is used, usually both sides of the neck are treated, whether or not palpable lymph nodes are present, a more intensive treatment being given when nodes are already demonstrable. The x-ray therapy is directed to fields sufficiently large to cover the whole neck area, both sides being treated on alternate days, a dose of from 150 to 200 r being given per field per day, a total dose of from 850 to 3,000 r being given each area, depending on the amount of lymph node involvement present. The factors employed are 200 kv., 4–5 ma., 0.5

[1] Presented before the Radiological Society of North America at the Twenty-second Annual Meeting, at Cincinnati, Nov. 30–Dec. 4, 1936.

[2] Period covers the years from 1924 to 1935.

mm. copper plus 1 mm. aluminum filter, at 40–50 cm. distance. The size of the fields used depends on the neck area to be treated, usually 9 × 12 cm. or 10 × 15 cm.

If no palpable nodes are present, a dose of from 800 to 2,000 r is administered to each side of the neck over a period of from ten to sixteen days. In some cases, especially those with advanced lesions in which interstitial irradiation is not advisable, a modified Coutard method of x-ray therapy is employed, both sides of the neck receiving a dose of from 3,000 to 5,000 r through 2 mm. copper filtration at 50–60 cm. distance, delivered over a period of 30 days. As a result of such intensive therapy, marked skin reactions may appear and hospitalization be required until the irradiation effect subsides.

Where neck node dissection has been decided upon, pre-operative x-ray therapy is administered to both sides of the neck. The dose given is 900 r per area over a period of six days, 150 r being administered to each side of the neck each day. Operation may be carried out within three weeks following x-ray therapy.

If radium is to be employed for external irradiation, it is applied in the form of a pack. In cases in which large quantities of radium are available, a large pack such as that in use at Bellevue Hospital, New York City, may be used. It consists of 5 grams of radium, distributed evenly over an area of 8 × 10 cm., filtered through 3 mm. platinum equivalent. The pack is applied at a distance of 6 cm. from the surface of the neck, and treatment is given each side of the neck on alternate days for a period of 20 days, thus giving 50,000 milligram-hours to each side of the neck.

In cases in which moderate amounts of radium are available, treatment of the neck areas may be carried out by the application of radium molds or small packs. The mold may be of a specially prepared wax and shaped like a collar around the neck. Its thickness varies from 3 to 6 cm., depending on the area and extent of the glandular involvement to be treated. The radium, in the form of tubes, is attached to the mold and distributed over its surface so as to cover the whole glandular area. The tubes should contain from 5 to 10 milligrams of radium or millicuries of radon, and filtered with 1.5 mm. of platinum or its equivalent. The dose is from 10,000 to 20,000 milligram-hours of radium, or 200 millicuries of radon is required for this type of mold.

In some cases in which definite large hard lymph nodes are present, a small pack is attached to either side of the neck. This pack is made of wax, or a wooden block, or a soft rubber sponge upon which is placed the radium in the form of tubes of 10 milligrams each, filtered through 2 mm. of platinum or its equivalent in lead. Usually 10 tubes are used, making each pack hold 100 milligrams of radium. The thickness of the pack is such as to separate the radium from the skin by from 5 to 6 cm. The portal size is 7 × 9 cm. The sides and top of the pack are covered with lead so as to enclose the tubes and restrict the radium rays which are emitted in all directions. The radium rays required are allowed to pass unhindered through the under surface of the pack and directed toward the involved gland area of the neck. The pack is held in place by a head bandage and remains on the patient until the predetermined dose is administered. Usually the dose given with this method is from 35,000 to 45,000 milligram-hours over each area, over a period of from 16 to 21 days.

Following irradiation of the lymph node areas of the neck the local lesion is treated with surgery, radium or x-rays, or a combination of these. During the course of the local treatment the patient is hospitalized.

1. In cases in which the lesion of the lip is localized, with slight induration, and in old persons with small localized lesions, in which no metastatic involvement is visible or palpable, the entire malignant area may be removed by surgical excision. Following healing of the local wound, radium may be applied to the area of operation with a molded surface applica-

tor of wax or rubber, and left in place for sufficient time to deliver the required predetermined dose, which depends on the extent and type of the original lesion present and the amount of surgery performed in its removal. The mold is fitted over the lip and is made to extend beyond the chin for fixation. The thickness of the mold varies from 0.5 to 2 cm. To its surface are attached radium tubes filtered through 1 to 1.5 mm. of platinum or equivalent. A sufficient number of tubes is used to surround the involved area, the dose given being from 1,000 to 2,500 milligram-hours. The tubes contain from 10 to 15 milligrams of radium or millicuries of radon each and the mold is left in place long enough to deliver the required predetermined dose.

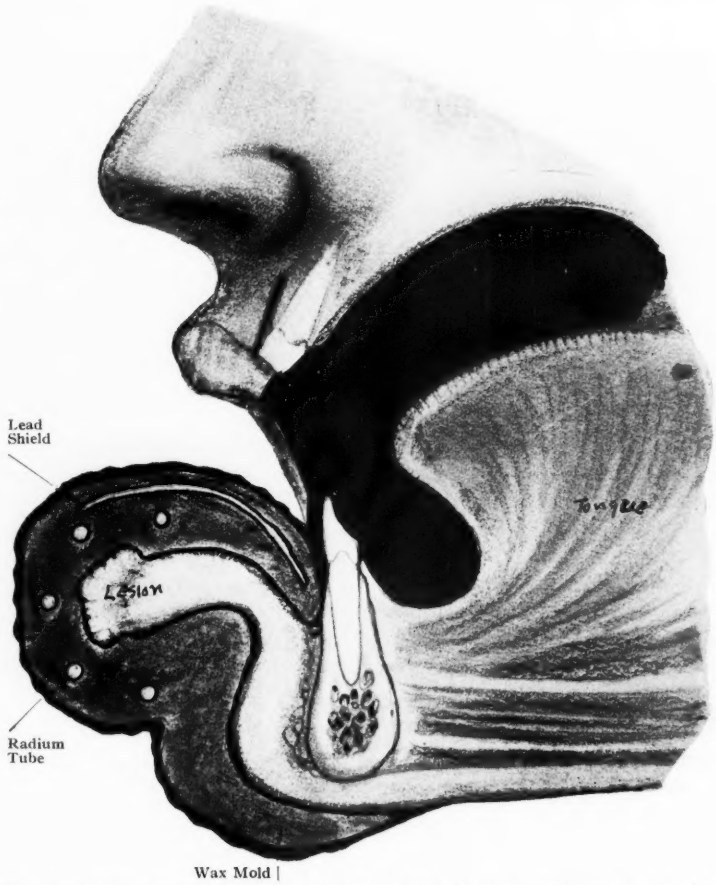


Fig. 1. Radium mold (cross-section) showing lead shield and radium tubes in place.

In cases in which block dissection of lymph nodes of the neck is carried out simultaneously with or subsequent to the local lip resection, post-operative high voltage x-ray therapy is given to the neck, a dose of from 800 to 1,000 r units being administered to each area over a period of eight days.

2. *Treatment of the Local Lesion with Radium.*—For this, the method employed depends on the location and extent of the lesion. Small localized areas may be

treated by (*a*) the application of surface molds, or (*b*) direct contact application of gold seeds.

(*a*) The molds (Fig. 1), of wax or rubber, are fashioned over the lip with the radium so as to surround it. The tubes contain from 5 to 10 milligrams of radium each. The mold remains in place long enough to give the predetermined dose, which is from 1,000 to 2,500 milligram-hours—

Fig. 2. Epithelioma of lip (before treatment).

Fig. 2-*A*. Healed lesion. Same case as shown in Figure 2.

in tube form fastened thereon, with a wax-covered lead shield over the tubes to restrict scattered radiation. The mold is fitted to the entire lip and is made to extend beyond the chin for fixation and is held in place by adhesive or tape bands around the head. It is usually from 0.5 to 1 cm. thick, the radium tubes, from two to four in number, filtered through 1 mm. of platinum, being affixed over the lesion area

Fig. 2-*B*. Radium mold in place: mold, wax 0.5 cm. thick; radium, 4 tubes; content, 10 mgr. each; time, 72 hours; dose, 2880 milligram-hours. Same case as shown in Figure 2.

usually from two to five days. In large ulcerated lesions the mold is fashioned in the same manner but is from 1 to 3 cm. in thickness, and is so constructed that the lip is pulled outward and downward. In this position the lesion is cross-fired from above, below, and anteriorly by the radium tubes, which are attached to the mold in sufficient number to surround the periphery of the lesion. Tube filtration is from 1 to 2 mm. of platinum, depending on the bulkiness of the lesion, and the tubes contain from 5 to 15 milligrams of radium each. The mold remains in place continuously except during meals when it is removed and cleansed and then put back in place until the required dose is given. The dose used is from 1,500 to 3,500 milligram-hours, over a period of from two to six days. The patient perceives little or no discomfort with this method of treatment (Figs. 2, 2-*A*, and 2-*B*).

(*b*) For very small lesions and keratotic spots, radon gold seeds may be fastened directly around or on the lesion with collodium and left in place until the required dosage is given. The seeds are from 0.5 to 1 millicurie in strength and are filtered through 0.3 mm. gold. The dose used is about fifty millicurie-hours per square centimeter.

Interstitial Radiation.—This method of procedure requires hospitalization when radium or radon needles are employed. In cases in which radon gold seeds are used

the treatment may be ambulatory. The needles are 27–35 mm. in length and contain 2 milligrams of radium each. The needle wall filtration is 0.5 mm. of platinum. The needles are inserted horizontally in two planes at right-angles to each other at the periphery of the lip lesion so as to form a cross-firing web around and through the lesion. As many needles are used, spaced about 0.5 cm. apart, as will completely surround the involved area. The dose given varies with the size of the lesion, approximately from 300 to 500 milligram-hours per cubic centimeter being administered over a period of from two to five days (Figs. 4, 4-*A*, 5, and 5-*A*).

Technic.—Under direct or conductive local anesthesia, the needles, already threaded, are grasped by specially prepared forceps and inserted around the tumor mass. They are kept in place by sutures through the surrounding normal tissues, using the threads already attached to the radium needles. To restrict stray irradiation the lip is covered with a molded lead protector. After the required total dose of from 1,000 to 3,000 milligram-hours is given, the needles are removed and the lesion treated with bland wet dressings until all inflammatory reaction has subsided, whereupon a bland ointment is applied until the lip is healed.

If a dose of 1,000 milligram-hours is required and five needles of 2 milligrams are available, these are left in place 100 hours: $5 \times 2 \times 100 = 1{,}000$ milligram-hours. With 10 needles, 3,000 milligram-hours may be secured: $10 \times 2 \times 150 = 3{,}000$ milligram-hours.

In some cases in which needles are not available and the tumor is quite bulky,

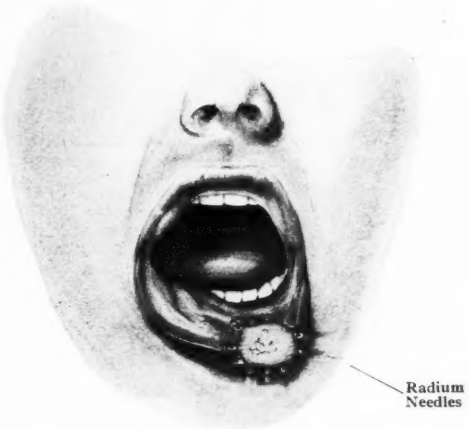


Fig. 3. Lesion on lip treated by insertion of radium needles.

radon gold seeds are used. The seeds are from 0.2 to 1 millicurie in strength, filtered with 0.3 mm. of gold, and are inserted in and around the malignant lesion 1 cm. distance apart under local anesthesia. The dose is about 50 to 133 millicurie-hours per cubic centimeter of involved tissue. The seeds are left in place permanently and in most instances cause no future discomfort. Post-radiation treatment is the same as when needles are employed (Figs. 4 and 4-*A*).

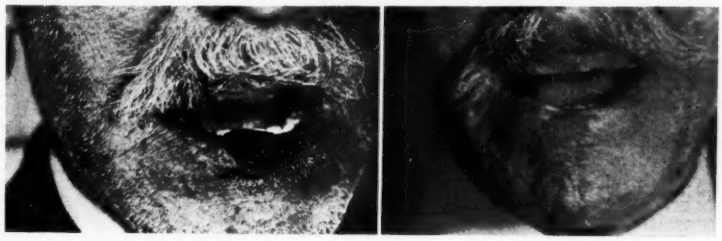


Fig. 4. Fig. 4-*A*.

Fig. 4. Squamous-cell epithelioma of lip, before treatment.
Fig. 4-*A*. Squamous-cell epithelioma of lip, healed, two years after interstitial treatment with radon seeds (1,000 mc.-hrs.). Same case as shown in Figure 4.

Occasionally ulceration necrosis follows interstitial radium therapy, and in cases in which healing does not ensue within a short time following treatment with wet dressings or ointments, excision of the involved area with the endotherm or surgical scalpel may be required. Extensive resection may call for subsequent plastic repair. The deformity following treatment depends upon the extent of the original destruction of the lip, being most extensive in the ulcerative types.

Fig. 5. Fig. 5-*A*.

Fig. 5. Epithelioma of the lip (before treatment).
Fig. 5-*A*. Healed lesion after interstitial radium therapy with radium needles: 3 needles, 2–9 mc. radon content each; 35 mm. long; time, six days; 0.5 mm. Pb filter; dose given, 666 mc.-hrs. Same case as shown in Figure 5.

In cases in which the malignant lesion extends to and involves the mucosa inside the mouth, the radiation must be planned to include such areas. Lesions at the angle of the mouth present a most difficult condition, and treatment with a radium mold applicator is preferable to interstitial irradiation in this area. The mold is fashioned in the same manner as that for the other portions of the lip, with an additional supporting mold within the mouth.

In those cases in which ulceration or painful scarring persists following radium therapy, necessitating excision and plastic reconstruction of the lip, the upper lip may be used for this purpose according to the methods described by others.

Occasionally, when there is a large, bulky tumor growth, removal of the excessive malignant tissue with endothermy is advisable, followed by radium therapy, in the manner already described.

Intensive X-ray Therapy.—In cases in which radium is not available or in which there is a very large ulcerating, infectious, bulky tumor involvement of the lip, intensive x-ray therapy may be administered. The x-rays are applied directly to the tumor lesion, the surrounding normal tissues being well screened off by lead or lead rubber shields. This must be done carefully and precisely, for excessive dosage used with this form of therapy is destructive to normal tissues. Before treatment, the protective shield is carefully cut out to fit the lesion exactly. Low voltage, unfiltered x-rays are used. The factors used are 100–150 kv., 4–5 ma., no filter, distance of 30–40 cm., field just sufficient to include the involved area. The dose given is from four to ten erythemas over a period of 21 days, four or five skin erythema doses being administered each day to the involved area. The protective shield about the area is altered to conform to the diameter of the lesion as the treatment progresses, so that exposure to the intensive caustic x-rays is limited to the involved tumor area.

Following treatment, the lesion is handled as would be any second degree burn. In cases in which marked inflammatory reaction takes place, wet dressings are applied for several days and a bland ointment dressing used until the lesion heals. As the tumor tissue is destroyed, healing takes place by the formation of fibrous scar tissue. In severe cases with noticeable defect formation, subsequent plastic excision—well beyond the irradiated tissues, in order to insure tissue properly supplied

with nutrition upon which to build the new lip—is carried out, not, however, until all irradiation reaction effects have subsided.

Recurrences.—These occasionally appear at the site of the previously healed lesion or just beyond its periphery. When small, they may be eradicated with surgery and the remaining malignant tissue treated with radiation or by insertion of small radon contact seeds.

In cases in which neck nodes persist after irradiation they may be surgically removed or treated with interstitial radium therapy. This is readily effected by inserting radon gold seeds of from 0.2 to 1 millicurie each into the palpable lymph nodes, the number of seeds thus employed varying with the size of the node being treated. A dose of from 100 to 300 millicurie-hours per cubic centimeter is used. The seeds may be inserted into the palpable nodes directly through the skin following local surface anesthesia or the skin may be incised, reflected back and the nodes exposed and localized and the seeds more accurately inserted in them.

During the course of treatment, due regard to general body health is required. Occasionally eating is rendered difficult because of the presence of radium application or soreness of the lip. Sometimes intensive irradiation may produce an inflammatory radiation reaction on the mucosa of the mouth and in such cases special care in feeding is essential to the patient's well-being. In some instances gavage or rectal feeding may be required, and occasionally hypodermoclysis, intravenous infusions of glucose or transfusions are necessary to bolster up the patient's general strength.

Following healing of the primary lesion, the patient is advised to protect the treated area against subsequent injuries. Nightly application of a bland ointment is advised to keep the healed irradiated tissues in soft condition.

In 1935[3] we reported on the results of irradiation treatment of 93 cases on the Bellevue Hospital Radiation Service; since then 67 cases have been added to our series, with even more beneficial results being noticeable.

[3] Kaplan, Ira I., and Krantz, Simon: Am. Jour. Roentgenol. and Rad. Ther., September, 1935, **34.**

CONCLUSIONS

A study of our cases leads us to the following conclusions:

Carcinoma of the lip is most commonly present in males over 40 years of age.

It rarely occurs on the upper lip.

Chronic irritation is an important factor in the etiology and excessive smoking has been indulged in by most of those so afflicted.

Syphilis is of little influence as only a very small number, less than 2 per cent, gave a positive Wassermann reaction.

Metastatic lymph nodes were not common concomitant occurrences in most cases and, when present, indicate advanced disease with poor prognosis. Local recurrence and metastasis were infrequent sequalæ in cases which did not exhibit lymph node involvement before the local lesion was treated. Lymph node metastasis occurred infrequently in cases in which the local lesion had been completely eradicated by intensive treatment.

The results of irradiation in cancer of the lip, based on our study of 160 cases, compare favorably with those following surgery, with the added advantage of no immediate operative mortality; moreover, mutilating scars are very much less likely to occur following irradiation.

55 East 86th Street

DISCUSSION

DR. WILLIAM E. COSTOLOW (Los Angeles, Calif.): Dr. Kaplan has very completely covered the problems of surgery and radiation in the treatment of cancer of the lip.

Fortunately, malignancy of the lip is quite amenable to treatment; first, because it is accessible, and second, because it is the lowest grade of malignancy of the intraoral growths. The majority of the growths are of Grade I and II, Broders' classifica-

tion. Practically 90 per cent fall in this group, which is undoubtedly the reason why they are slow to metastasize and are more amenable to treatment.

I disagree with Dr. Kaplan in his statement that in all cases of lip malignancy the gland-bearing areas should be irradiated regardless of whether surgery or radium is used in treating the primary lesion. In the past eleven years, in a series of 630 cases of lip malignancy treated in our clinic, approximately 10 per cent did not have glands at the time the primary lesion was treated, nor did they develop glands later. Had we irradiated the neck glands in all of these cases, we would have treated at least 90 per cent unnecessarily.

I do not believe that there is any more justification for the routine irradiation treatment of the neck glands in carcinoma of the lip than there is for the routine block dissection, which has been discontinued for a number of years.

In order that the irradiation treatment of malignancy in neck glands shall be efficacious, it must be very thorough. Even though glands are not palpable and we are treating the neck on the supposition that malignancy is present, it is about a 90 per cent chance that it is low grade malignancy, squamous cell with pearl formation, highly radioresistant. Consequently, it would be necessary to give a very radical irradiation treatment. We do not believe that it is justifiable to subject the patient to such a radical treatment unless there is definite evidence that pathology is present in the glands.

Another reason: Suppose we should go ahead and give this thorough irradiation to the neck glands, then a few months later the patient should develop a metastatic area; we would be greatly handicapped in any further treatment. We would be hesitant to go ahead with another radical fractional irradiation treatment, and even surgical resection would be difficult.

We have had some experience with surgical resection in some of these cases and find it is very difficult on account of the severe fibrosis produced by the previous irradiation. This treatment might be justifiable in high grade malignancies, in young individuals. In some cases in which the previous biopsy showed a high grade malignancy—for instance, a Grade IV Broders' classification—we have proceeded to irradiate all the neck glands. All these patients have eventually died of cervical metastasis.

I believe that Broders found the same results in going over the material at the Mayo Clinic; namely, all the patients with lip cancer, Grade IV, are dead.

Speaking of the youngest cases—the youngest patient in our series was 12 years of age. This was a Grade I epithelioma, and the patient has been well for three years.

Our plan of treatment is to apply radium to the primary lesion. We prefer radium on account of the better cosmetic results.

I wish to compliment Dr. Kaplan on the very beautiful primary results he has shown here. We agree perfectly with him regarding his methods of treatment of the primary lesion.

In cases in which there are glands present, we proceed with a thorough fractional irradiation to the neck glands. Ordinarily, that is all we do; we depend on that. In some cases in which a localized mass persists later, which apparently is not completely adherent and apparently has not broken through the capsule, we have attempted resection. Surgery usually is reserved until the later manifestations following extensive irradiation.

We have practically given up interstitial irradiation in the treatment of the neck glands.

DR. JOSEPH P. O'BRIEN (Buffalo, N. Y.): Dr. Bowing mentioned the advisability of removing a section for diagnosis. A section certainly should be taken for diagnosis and, if positive for malignancy, other factors of importance may be determined—the grade of malignancy, metastasizing possibilities, the prognosis, etc.

Interesting in respect to that phase are several cases: one, a large spongy tumor

presenting in the ampulla of the rectum which proved, on biopsy, to be a hemangioma. Considerable bleeding followed the removal of a section of this tumor.

Other conditions which may simulate carcinoma of the rectum are inflammatory strictures, tuberculosis, and amoebic ulceration.

In regard to the treatment, it may be interesting to compare the treatment used by Dr. Bowing with that followed at our institution. Given an inoperable—or operable—case of cancer of the rectum, external x-ray is applied, using 200 kv., 25 ma., at a distance of 80 cm., with 0.5 mm. of copper filtration; 200 r are applied daily, alternating front and back of the sacrum and lower abdomen. A total dose of 3,000 r as measured in air is given on each side.

In conjunction with this, some form of interstitial radiation is administered—radon seeds in selected cases, with 0.3 mm. of gold filtration. Direct application of radium tubes in tandem, 100 mg. each, is made to the tumor area for four hours every other day, for a total of 4,000 milligram-hours.

Another form of external treatment, the radium pack, is used: three ports, a gram and one-half of radium to each port, using a daily dose of 200 r, alternating front and back, until we build up a total dose of 5,000 r on each skin surface.

We do not fulgurate malignant tumors of the rectum as described by Dr. Bowing. The bleeding sometimes subsides even before the conclusion of the treatment. There is sufficient destruction of the tumor tissues.

I want to emphasize also what Dr. Bowing has said about the fact that radium and x-ray should be used in conjunction with surgery—additional equipment for the use of the surgeon. Only by co-operation of the surgeon, radiologist, and internist will we be able to lower the high mortality rate in carcinoma of the rectum.

Dr. Walter S. Lawrence (Memphis, Tenn.): Discussing Dr. Kaplan's paper: in justice to a few young men who are in the house who may not have had as long experience as some of the rest of us, I would like to suggest that I believe Dr. Kaplan's method will cure practically all cases. But I also believe that if one had a very persistent and annoying wart on the tip end of his tongue, where such do sometimes occur, that if the tongue were brought forward and fixed outside of the mouth for a given time, screened off with a piece of lead on top of it and given 4,000 r from a 1,250,000 volt x-ray machine, such treatment would cure the wart.

In other words, I believe that the majority of these cases of cancer of the lip may be cured by somewhat easier, less expensive, and less persecuting methods than those advocated.

I have nothing to say in criticism of his method of treating carcinoma of the lip that has glandular metastasis. I think in these cases the best is none too good. But in treating a great many of these cases, I think we have to consider the social status, the financial status, and the amount of persecution which the patient is willing to stand to get rid of his possibly not very serious lesion. All of them are serious, but certainly many of them can be enrtiely obliterated and remain well for the rest of the patient's life by methods somewhat less expensive, less persecuting, and simpler than those Dr. Kaplan advised in some cases.

Of course, if the patients are wards of the State, the amount of money we spend on them and the amount of trouble we go to merely means practice to our understudies who do most of the work. Or if the patient is immensely wealthy, we can give him as much treatment as would seem reasonable or unreasonable; but in the ordinary "run of the mine," the man who is making his own living and needs the use of his lip and tongue and other parts of his mouth daily, I think he can be treated in an easier way.

Before closing I want to mention one thing that I do not believe Dr. Kaplan mentioned—the protection of the mucosa, of the gums, and the tongue by fitting

pieces of lead rubber over them. If the lesion is in the corner of the mouth, you can cut the rubber so as to slip it around, and with the patient closing his mouth, the lead rubber will protect the upper gums and the lower gums, and avoid the necessity of a great deal of pain from reaction if we are going to give extremely large doses to the outside.

Now continuing the point of using less extreme measures—they *will* cure, unquestionably, but I believe other methods will cure also.

The first case of cancer of the lip that I ever treated, some twenty-eight years ago, I gave x-ray therapy, but how much or how little no one knew at that time. I do know that I gave the man 27 treatments, a little tiny bit every other day, and I do know that he had a large lesion on the front of his lip, of quite long standing. It was of the squamous-cell type, I admit, but he got entirely well and remained entirely well for 25 years.

My method of treating these cases is to put a piece of soft lead rubber in the mouth and give about one and a half erythema doses, filtered through about four millimeters of aluminum, which takes possibly ten to fifteen minutes. I repeat that dose once a week until healing is well on the way, generally giving not over three treatments.

One other point: I do not believe it is wise to treat the gland-bearing area unless it is involved, in some measure anyway. I think if it does nothing else, it lowers the resistance of that tissue, particularly if you give it 2,000 or 3,000 r.

I enjoyed Dr. Kaplan's paper ever so much and I am sorry I felt it necessary to make a little criticism of it.

DR. IRA I. KAPLAN (closing): It is hard to assume the responsibility for everything one says without being able to demonstrate exactly why one feels that that is the correct thing to do. We have an opportunity in our service in the Cancer Division of the City Hospital organization, of which I happen to be the Director, of having at our disposal a hospital of 200 beds for custodial cancer cases only. It is the largest in the United States for that purpose. There we receive patients from every hospital in New York City and from private physicians who have cases that no longer can support themselves, and thus we have an opportunity of observing in these numerous cases—over a thousand a year—just what happens in cancer conditions that have been treated elsewhere by all sorts of methods. Our death rate is about 90 per cent, and we therefore are dealing with the cases that have been treated by almost every method and have been abandoned. In that way we learn what has happened when other methods have been used.

Our methods as described to-day are not always the best methods. We know that, because even from our own service at Bellevue we must occasionally transfer cases to my other service at the Cancer Institute.

We may be right in our own way, or we may be wrong, as Dr. Costolow and Dr. Lawrence say, in treating gland-bearing areas with pre-operative or pre-local radiation. We have a certain responsibility to our patients and we would rather make the mistake on the safe side than take a chance otherwise. We have found that if we are required later to irradiate patients for glandular metastasis, who were not irradiated pre-operatively or before receiving radium therapy, the condition is almost hopeless and much more difficult to control. For that reason we believe that we must first irradiate all cases over the gland-bearing area and then treat the local lesion.

Dr. Lawrence is quite right in saying that we can treat some of our lesions in a mild manner, but how often have all of us seen carcinomatous conditions recuperate, as it were, grow again, and create a condition that is horrible in the end. Those last two slides that I showed you were of cases treated just that way—in a temporizing manner. One was treated in a very good hospital—had a radical resection of the lesion, and then you saw the neck all breaking out with malignant ul-

cerations, absolutely not amenable to any kind of treatment whatsoever.

Dr. Lawrence uses perhaps the dermatological method of treating cancer. You sometimes can treat cancer that way. Occasionally we can remove the whole carcinomatous lesion of the lip with the biopsy—also that has occurred with us.

Unfortunately I did not have the photographs with me to show you the cases treated solely by x-ray therapy. We do treat with low voltage x-ray therapy, as Dr. Lawrence suggested, but we use a little heavier filtration of aluminum, and we get good results.

As far as economy is concerned, you were right. When it comes to the ward cases we are not so particular how much free money we spend. We just spend it! When we have the rich person, we try to spend his money. But you find he is the most difficult man to get to pay his bills, so for him we must reduce the amount of time we require for treatment.

The middle class patient who requires a radium mold comes to us on Friday, is placed in a private hospital at a minimum rate, keeps the mold on Friday, Saturday, and Sunday. Monday morning we take it off, and he goes to business that day. Thus he loses practically a little over a working day, which isn't much to pay for cancer treatment. And we judge our rates according to the patient, of course. The cost of treating patients that way, with a small radium mold and with ambulatory treatment in the office of the x-ray therapist, is really inconsiderable. It is not to be considered at all when you figure that, after all, one of these cases may be extensive carcinoma.

So if you treat them all alike, the easy ones and the hard ones, in the long run you are going to do something for carcinoma that is really worth while.

OSTEOPETROSIS[1]

By R. MANGES SMITH, M.D., Department of Roentgenology, *and* AUSTIN T. SMITH, M.D., Department of Rhinology, Jefferson Medical College, *Philadelphia*

OSTEOPETROSIS, more commonly known as marble bones, was described originally in 1904 by Albers-Schönberg (1). The condition first appeared in the English literature in 1922, when G. G. Davis (2) collected seven cases from the foreign literature and added another one. Various names have been used in referring to the condition, *i.e.*, Albers-Schönberg disease; *marmorknochen*, or marble bones; lime gout; osteosclerosis with anemia, and osteosclerosis fragilis generalisata. The name "osteopetrosis" was suggested and used by Karshner (3) in 1926. It is not entirely suitable, because literally it means "stone-like bone," whereas, Pirie (4) showed the bones to be more like chalk in consistency. For the same reason, "marble bones" is a misleading term, despite the fact that the outstanding characteristic is a generalized increased radiopacity of the bones resembling marble. Another characteristic is the fragile nature of the bones. It might be better to use a term more descriptive of this chalk-like consistency, such as osteocretosis.

The etiology of this condition is unknown. Observers agree on an abnormal calcium metabolism of the bones but cannot satisfactorily explain it. The rôle of the parathyroid secretion and vitamins has not been established. In many cases serum-calcium and phosphorus have been studied without indicating any definite variation from normal. Hereditary influence is considered a strong factor. Howard Pirie (4) reports a study of four cases in one family—the mother and her three children. In one child the condition was first suspected while it was a fetus *in utero*, due to the density of the vertebræ as seen roentgenographically. After birth, examination revealed the early stages of marble bones. Pirie studied the increase in the condition as age advanced. He suggested that infection plays a more important rôle in the production of the condition than endocrine disturbances.

The symptomatology varies, depending upon the stage to which the condition has advanced. The liver and spleen are frequently enlarged. Anemia is common, due to transformation of the medullary canal into compact bone. Imperfect dentition is usually present due to disturbance of the dental calcification as well as to a poor blood supply. Frequently, the mandible is necrotic because the main blood supply is cut off and there is no collateral circulation. The cranial nerves are often involved due to pressure on them because of bony changes in the canals. Poor eyesight and blindness are not uncommon. In a number of cases the condition was first discovered when spontaneous fracture of a bone occurred. The bone becomes chalky and fragile from the excess calcium.

CASE REPORT

This report of another case of osteopetrosis is presented not only because of its rarity and its mysterious etiology, but also because it emphasizes the importance of its recognition. This patient was referred for treatment of a chronic right maxillary sinusitis. In addition to the usual roentgenologic appearance of the skeleton, this case presents some unusual features.

The patient, a white female, aged 13, was admitted to the Jefferson Medical College Hospital, May 9, 1934, on the service of Dr. Fielding O. Lewis. Her chief complaint was a discharging sinus underneath the right eye, which had persisted for ten months.

Family History.—Negative.

[1] Presented before the Radiological Society of North America at the Twenty-second Annual Meeting at Cincinnati, Nov. 30–Dec. 4, 1936.

Past History.—She had been a normal baby, weighing eight and a half pounds at birth. She was breast-fed for 13 months. Her health was good until the age of five, when she began to complain of "sore teeth." In September, 1930, at the age of nine, she was admitted to the Ohio Valley General Hospital because of pus draining from the left lower molar region. Her jaw had been swollen for two and a half years prior to this time. A diagnosis

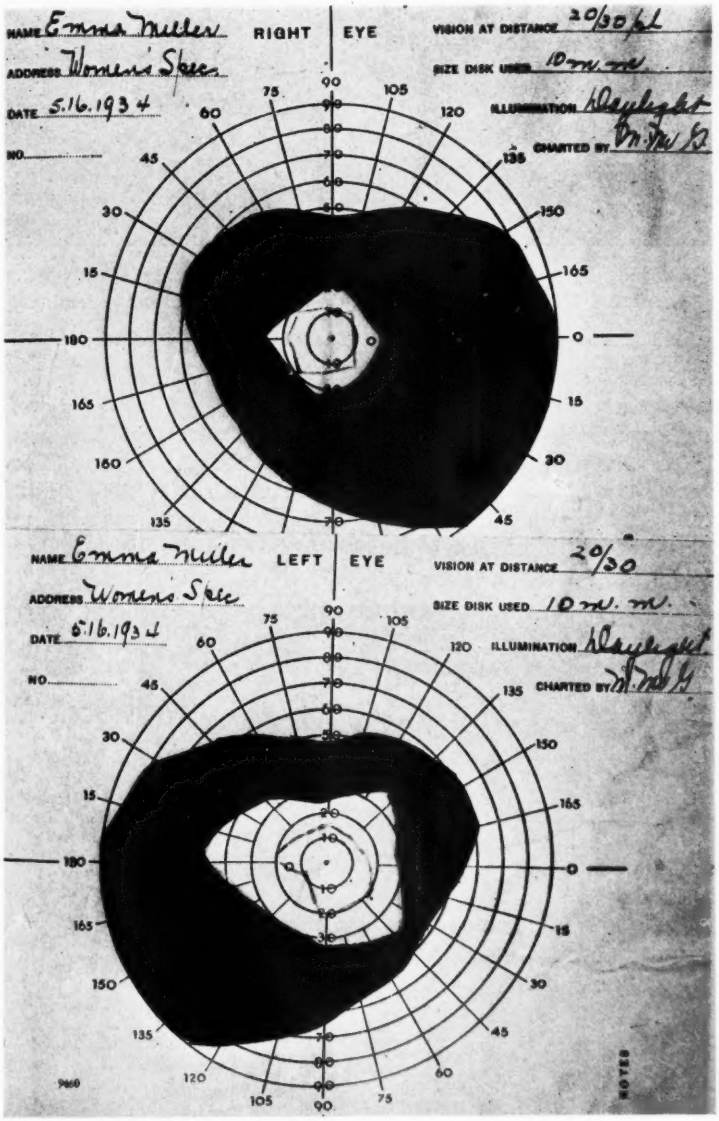


Fig. 1. Visual fields show no optic atrophy.

of necrosis of the mandible was made. A sequestrum was removed from this area two months after admission. There was a marked secondary anemia (hemoglobin 50 per cent; red blood cells, 2,500,000). Aside,

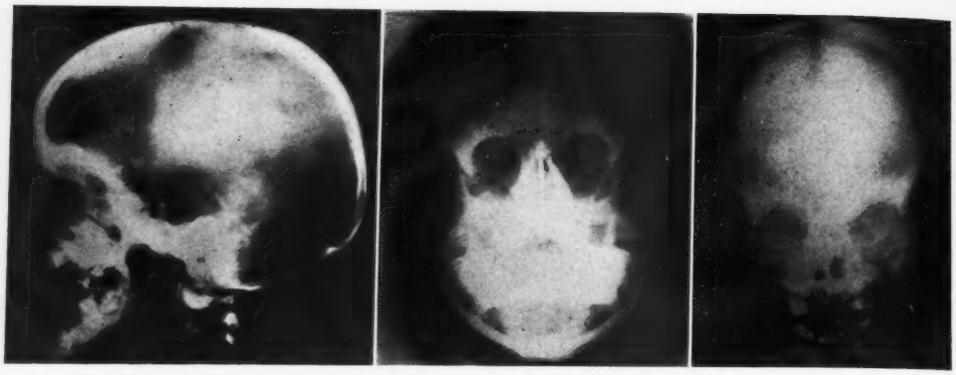


Fig. 2. Fig. 3. Fig. 4.

Fig. 2. Frontal sinuses absent; bones of the face show an increase in density.
Fig. 3. Maxillary sinuses quite dense.
Fig. 4. Bones of the skull dense. The sella turcica is of normal size.

from the secondary anemia the laboratory studies were negative. Blood calcium was 11.7 mg. per 100 c.c. An x-ray diagnosis of chronic osteomyelitis of the left lower jaw was made. On her second admission to the same hospital in March, 1931, the infection. An x-ray study of the chest, skull, and bones of the legs was made and reported as follows: "There is a general constitutional bone condition present, having the appearance of marble bone, with no definite bone structure present

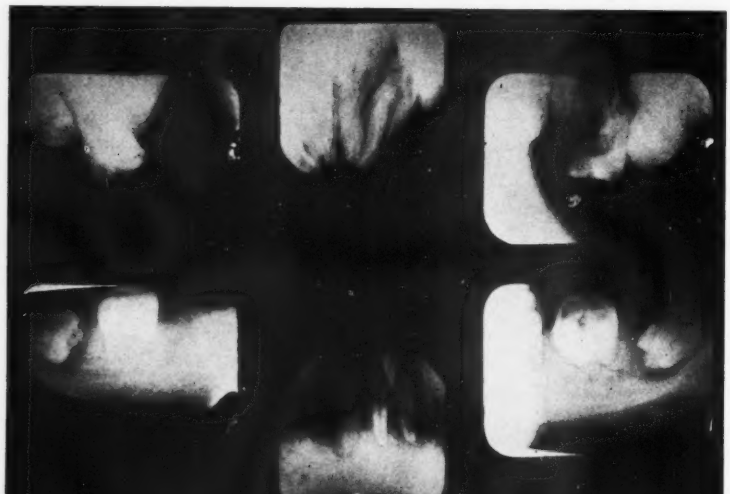


Fig. 5. Imperfect dentition; infection and caries of the erupted teeth.

jaw was still swollen. Another piece of necrotic bone was removed and some infected teeth were extracted. Cultures of pus from the mandible showed a mixed at any point. The pituitary area shows very dense clinoid processes and sella turcica. The pituitary area is encroached upon, apparently by thickened bone. The

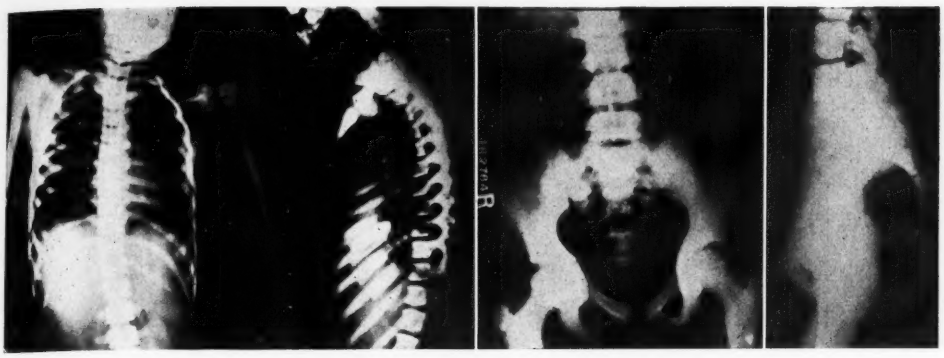


Fig. 6. Fig. 7. Fig. 8. Fig. 9.

Fig. 6. Heart and lungs are normal.
Fig. 7. Thoracic vertebræ, ribs, and sternum show uniform increased bone density.
Fig. 8. Liver and spleen are normal.
Fig. 9. Lumbar vertebræ and bones of the pelvis are quite dense.

appearance of the pituitary fossa would indicate probable pituitary disturbance."

Present Illness.—The infection in the left mandible subsided, and the child's condition was satisfactory until June 1933. At this time there was pain and swelling beneath the right eye. The swelling gradually increased to include the entire eye and was accompanied by a high fever. Three or four days after onset an incision was made underneath the right eye and a large amount of pus escaped. Drainage persisted until admission to the Jefferson Hospital. A month prior to admission a sequestrum of bone was discharged. She had a continued fever of 99 to 100°.

Physical Examination.—The patient is an anemic young female aged 13. The lower part of her face is very small and out of proportion to the rest of the head. She has much the appearance of an edentulous old woman. There is swelling of the right side of the nose and infra-orbital region with a sinus underneath the right eye from which foul-smelling pus is draining. The right nasal chamder is filled with pus coming from the right middle meatus. The sinus opens on to the cheek from the right antrum. The teeth are in very poor condition. The tonsils are enlarged. The remainder of the physical examination is negative. The laboratory studies show a marked secondary anemia but nothing else of importance. The blood calcium is 9.79 mg. and the blood phosphorus 4.9 mg. per 100 c.c. The eye grounds appear paler than normal but show no optic atrophy (Fig. 1).

Figs. 10-*A* and 10-*B*. The bones of the extremities show marked increase in density. There is clubbing and shelving of the diaphyses.

Roentgen Examination.—Because of the draining sinus, films of the sinuses were first taken. A diagnosis of osteopetrosis was made. The rest of the skeleton was studied subsequently.

Fig. 10-*B*. See caption under Figure 10-*A*.

The frontal sinuses are absent (Fig. 2). The other paranasal sinuses are so dense that they appear to contain no air. The bones of the face and skull all show a uniform increase in density. Both maxillæ are quite dense and there is no evidence of bone destruction (Fig. 3). The density is perhaps more marked in the right maxilla. The density is so great that it precludes the possibility of determining the site of the draining sinus. The bones comprising the base of the skull are very dense. The sella turcica is normal in size; the posterior clinoids are club-shaped and quite dense (Fig. 4). There is no evidence of increased intracranial pressure. The left orbit is slightly larger than the right one.

The mandible does not show the same extent of involvement in the process as the rest of the bones. There is no evidence of the previous necrosis. The imperfect dentition is marked. The unerupted teeth lie at odd angles. The erupted teeth are carious and infected. There is marked recession of the alveolar processes, and in the upper right bicuspid region there is infection of the alveolar processes (Fig. 5). This is probably a part of the lesion producing the discharge from the draining sinus.

The heart and lungs are normal in appearance (Fig. 6). The paratracheal lymph nodes on the left side are enlarged. The ribs, sternum, and thoracic vertebræ all show the typical increased bone density of osteopetrosis (Fig. 7).

The liver and spleen are slightly enlarged (Fig. 8). The kidneys are normal in size and occupy a normal position in the abdomen. The lumbar vertebræ are more completely involved in the process than the thoracic vertebræ. The bones of the pelvis, sacrum, and coccyx are quite dense (Fig. 9).

There is clubbing and shelving of the diaphyses of the long bones of the extremities. The epiphyses and diaphyses of these bones show a marked increase in density. The epiphyseal lines are irregular due to softening. The age-development of the epiphyses appears to be normal. There is little evidence of cross-striations in the diaphyses of the long bones, which seems to indicate that the condition is long-standing (Fig. 10).

The carpals, metacarpals (Fig. 11), tarsals, metatarsals (Fig. 12), and phalanges all show marked involvement.

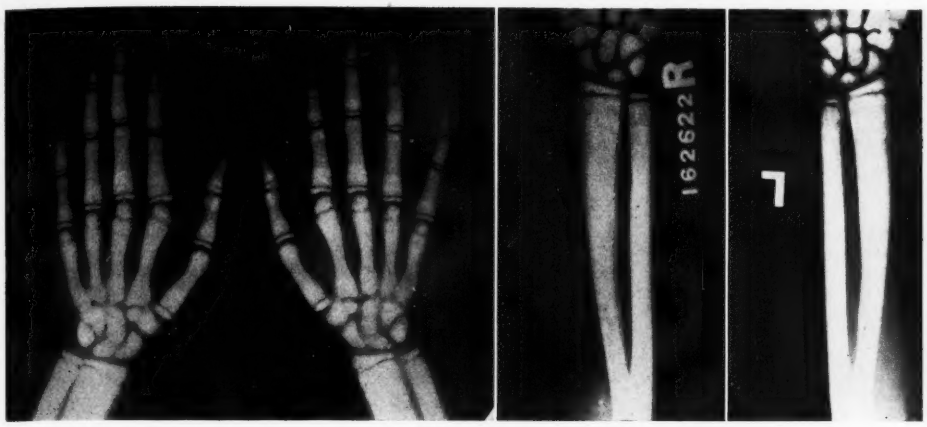


Fig. 11. The carpals and metacarpals show uniform increased density.

There are no areas of softening in the carpal or tarsal bones. In the epiphyses of the terminal phalanges of both great toes there is a longitudinal break in continuity. It is as though the center of these epiphyses had softened and separated, each one into two parts (Fig. 12).

COMPARATIVE STUDY

We were fortunate in being able to make a comparative study of this case with the one reported by Shallow, Davis, and Farrell (6). Despite the fact that our patient was younger in years than theirs, as evidenced by bone density, the disease was more widespread and uniform in distribution. (Chart I.) There was no evidence of cross-striations in the epi-

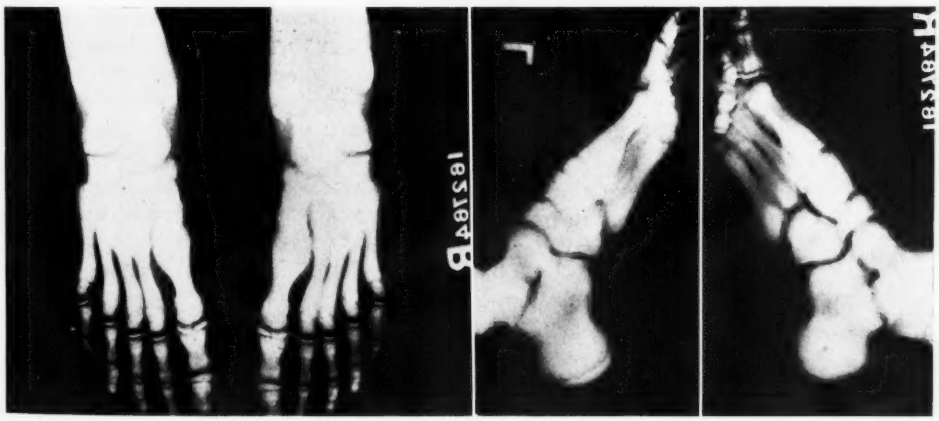


Fig. 12. The tarsals, metatarsals, and phalanges are increased in density. There is a softening in the epiphysis of the proximal phalanges of both great toes.

There is no evidence of old or recent fracture in any of the bones of the skeleton. This is a typical case of osteopetrosis.

physeal ends of the diaphyses of the long bones. Since the transverse bands of density are lost, it is reasonable to assume

that either there was no interruption in the activity of the disease or that the disease had progressed to such an extent that cross-striation had been obliterated. Clubbing and shelving of the epiphyseal ends of the diaphyses of the femora and tibiæ is more marked in this case. This is another indication of the duration of the condition. There are osteomas on each descending ramus of the pubis. These proliferative changes were not evident in their case.

In this case the mandible was well preserved—the bone was less dense than bones elsewhere. Dentition was poor due to disturbance of calcium balance rather than to poor blood supply. The prominent feature of the case of Shallow, *et al.*, was complete sequestration of the mandible.

The tables of the skull are thinner in our case. The sella turcica is normal in size and the clinoids are increased in density; in their case the sella was unusually small. The architecture of the bodies of the cervical vertebræ was well preserved in this case while in the other one, the anterior, superior surfaces of these bodies were irregularly softened and somewhat flattened.

There was no evidence of old or recent fracture of any of the bones of the skeleton, while in the other case there were multiple rib fractures.

Unfortunately, films of the feet were not made in their case, and we were unable to determine if there were any areas of softening similar to those seen in the epiphyses of the terminal phalanges of the great toes in this case.

CHART I. COMPARISON BETWEEN THE OUTSTANDING FEATURES OF THIS CASE WITH THE ONE REPORTED BY SHALLOW, DAVIS, AND FARRELL (6)

	E. M. (Author's Case)	M. F. (6) (Case of Shallow, Davis, and Farrell)
Sex	Female	Female
Age	13	16
Skull	Bones thinner	Bones more dense
Sella	Normal	Unusually small
Sinuses	Obscured	Obscured
Maxillæ	Necrotic	No infection
Mandible	Not infected	Complete sequestration
Dentition	Imperfect	Imperfect
Vertebræ	Normal architecture	Cervical vertebræ show softening
Extremities	Uniformly dense	Multiple cross-striations
Femora	Clubbing	Clubbing
Tibiæ	Shelving	No shelving
Pelvis	Osteomas	Normal development
Feet	Areas of softening in epiphysis of great toes	Not x-rayed
Fracture	No evidence	Multiple rib fractures (old)

SUMMARY

(1) A case of so-called osteopetrosis is discussed in detail.

(2) The more descriptive term of "osteocretosis," literally "chalky bones," is suggested for this condition.

(3) The classical skeletal changes are present, along with necrosis of the maxilla.

(4) An unusual longitudinal area of softening in the epiphyses of the great toe terminal phalanges is described.

(5) The imperfect dentition, which is usually a feature of osteopetrosis, is illustrated.

(6) Certain features of this case are compared with those reported by Shallow, Davis, and Farrell (Chart I).

REFERENCES

(1) ALBERS-SCHÖNBERG, 1904 and 1907.

(2) DAVIS, G. G.: Arch. Surg., **5,** 449–463.

(3) KARSHNER, R. G.: Am. Jour. Roentgenol. and Rad. Ther., **16,** 405–419.

(4) PIRIE, A. H.: Development of Marble Bones. Am. Jour. Roentgenol. and Rad. Ther., August, 1930, **24,** 147–153.

(5) MAYER, O. B., and PITTS, T. A.: Osteopetrosis: Report of Case. Jour. Am. Med. Assn., July 1, 1933, **101,** 22–24.

(6) SHALLOW, T. A., DAVIS, W. B., and FARRELL, J. T., JR.: Osteopetrosis. Ann. Surg., September, 1934, **100,** 512–517.

DISCUSSION

DR. SAMUEL BROWN (Cincinnati): It may be of interest to you to know that I have at the present time six cases of marble bones under observation and all were found in the same family. The hereditary tendency is self-evident.

DR. ALFRED C. SIEFERT (Oakland, Calif.): I would like to ask Dr. Smith whether these patients were foreign-born or whether they were native Americans.

DR. CLERF (in behalf of Dr. Manges Smith): Unfortunately, I cannot answer that question.

DR. BROWN: I can answer about the six cases I have: they are all of them American-born.

HUMAN AUTONOMIC PHARMACOLOGY
V.—THE EFFECT OF ACETYL-BETA-METHYLCHOLINE (MECHOLYL) ON THE ATONIC COLON[1]

By A. MYERSON, M.D., PURCELL G. SCHUBE, M.D., *and* MAX RITVO, M.D., *Boston*

From the Division of Psychiatric Research, aided by grants from the Rockefeller Foundation, the Commonwealth of Massachusetts, and the Milton Fund; and the Psychiatric Clinic of the Boston State Hospital

THE importance of the presence of choline derivatives for the maintenance of normal gastro-intestinal function was first demonstrated by Weiland (1) in 1914 and again by le Heux (2) in 1918. They showed that the isolated gut contained choline and that the activity of this gut decreased as the choline was washed out. The action of choline itself was feeble, but, when in the gut and changed to acetylcholine, it was found to exert an influence many times greater. Acetylcholine was thereupon regarded as a peristaltic hormone, and in 1921 Loewi (3) showed that there was a general relationship between acetylcholine and parasympathetic action, and that the action of the drug upon the parasympathetic nervous system was stimulative.

During this time a number of choline esters have been synthesized—all apparently having a stimulative action upon the parasympathetic nervous system. Among them is acetyl-beta-methylcholine (mecholyl).[2] This drug has been studied by a number of workers, most of them noting that their results in general were uniform and similar. The effect of mecholyl upon the gastro-intestinal tract has, of course, been investigated (4) (5). It is the purpose of this paper to add to this present literature a study on the effect of this drug and its nullification by atropine on the colon of man.

METHOD

In the course of a study by one of us (Schube) of the gastro-intestinal tract in cases having abnormal mental states, it was observed that in the well-delineated cases of dementia præcox there was frequently a decrease in the tonus and the motility of the colon which resulted in a delayed emptying time. It was felt that this type of colon was the most suitable upon which to observe the effects of mecholyl.

General Controls.—To control the study, a group of 48 cases of dementia præcox was used. These were selected at random from the available hospital population, the only criteria being the specificity of diagnosis.

Specific Controls.—Each case of dementia præcox selected for the mecholyl study was used as a control on itself and on the entire mecholyl group.

Each individual used in the study received a cleansing enema and two hours later a barium enema. This latter was followed under the fluoroscope and the barium allowed to run in until the colon was filled. In the control studies the tonus and motility, as well as the rate of emptying of the colon, were followed on successive days under the fluoroscope to complete emptying. In the 12 cases receiving mecholyl, this drug was administered after the colon had been filled with barium. The action of the drug was then followed by fluoroscopy and by x-ray films at approximately 5-, 10-, 20-minute, 1- and 24-hour intervals. In the five cases receiving mecholyl and atropine the action of the mecholyl was followed at 5-, 10-, and 20-minute intervals; the atropine was then administered and followed at 5-, 10-, and 20-minute and 24-hour intervals.

In all instances the dosage of mecholyl was 30 mg., and of atropine sulphate $^1/_{100}$ gr. All drugs were given subcutaneously in the region of the deltoid muscle.

[1] Read by title before the Radiological Society of North America at the Twenty-second Annual Meeting at Cincinnati, Nov. 30–Dec. 4, 1936.

[2] We are indebted to Merck and Co. for the mecholyl used in this work.

Terms.—"Tonus"—the tone of the musculature of the colon as evidenced by the haustral markings and by the diameter of the lumen of the colon. "Motility"—the movement of the walls of the colon in either or both transverse and longitudinal axes. "Emptying time"—the time required, in days, to clear the colon of its barium content.

RESULTS

General Controls.—Of the 48 cases of dementia præcox, the colon tonus was abnormal in 75 per cent; in 44 per cent it was decreased, and in 56 per cent it was increased. In 71 per cent of the cases the colon motility was abnormal, *i.e.*, decreased. The time required for the emptying of the barium enema ranged from four to 14 days.[3]

Specific Controls.—Of the 12 cases used, the colon tonus was normal in four and decreased in eight cases. The motility of the colon was normal in three cases and decreased in nine cases. The time required for the emptying of the barium enema ranged from four to 12 days.

Mecholyl.—After the injection of mecholyl, in every instance there was marked evidence of an increase in the tonus and in the motility of the colon. As each colon was followed under the fluoroscope there were at first irregularly scattered areas where the tonus would suddenly appear to be increased as evidenced by a deepening and irregularity of the haustrations. These haustrations would frequently disappear entirely, leaving a spastic area from which the barium would be entirely evacuated. As suddenly as the increased tonus appeared, it would in many instances disappear and there would appear in another place another area of increased tonus. In some cases the movement of the colon would be so marked that x-ray films when taken would be definitely blurred. The increased tonus and motility were not confined to any one specific portion of the colon, but in an irregular and general way occupied the entire colon and rectum. They appeared in five minutes, rapidly reaching a maximum of effect at that time and continued thus for more than an hour, after which the colon appeared to have an increased tonus for at least 24 hours. In some of the cases, in addition to the increased tonus as evidenced by increase in the haustral markings and irregularity, and the decrease in the transverse diameter of the colon, there would be a definite decrease in the long axis of the colon; sagging loops would be straightened and marked flexures would tend to flatten out.

Due to the increased tonus and motility, during the first 30 minutes the patients would have one or more evacuations which were imperative and which could not be restrained. The mecholyl did not appear to affect the anal sphincter, and any attempts which were made to retain the barium were purely voluntary and unsuccessful. In every case at the termination of the 24-hour period there had been two, three, or four evacuations resulting in a colon which was practically free of barium.

Mecholyl and Atropine.—In those cases in which mecholyl and atropine both were administered, the atropine was given 20 minutes after the mecholyl, *i.e.*, at the height of the mecholyl action. As the atropine effect would manifest itself, the increased tonus and motility of the mecholyl would become definitely lessened and in some instances disappear; sometimes the colon would appear larger in its transverse diameter than before. Occasionally a definite imperative urge to evacuate would slowly disappear as the atropine became effective and as the patient was observed under the fluoroscope, the rectum would enlarge and the increased tonus become less. In cases wherein such evacuations were presented at the end of 24 hours, the colon still retained large amounts of barium, in marked contrast to those patients who had received only mecholyl. At the end of 24 hours the relaxed colon had returned to approximately its original state of tonus and motility.

[3] The detailed study of the colons of this group of cases will be reported at a later date.

The following are several case reports selected from the group upon which this study is based.

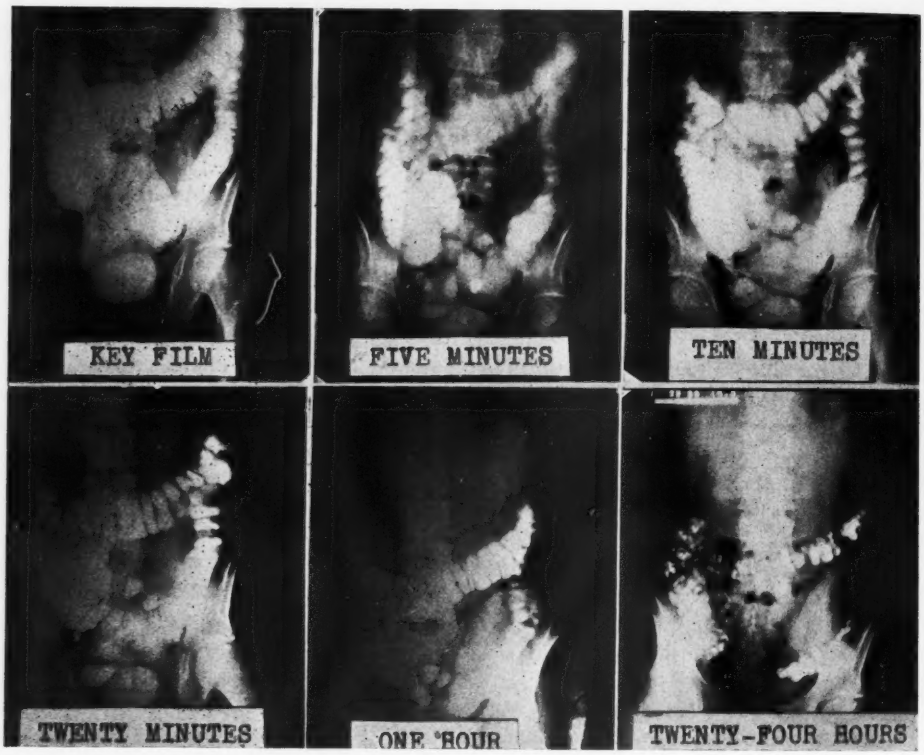


Fig. 1. Case 1. The key film shows the colon atonic and dilated, with shallow haustrations. The films after the administration of 30 mg. of mecholyl show a marked increase in the tonus; the haustral markings are increased in number and depth. At 24 hours, the colon is almost entirely empty and spastic.

PROTOCOLS

Mecholyl.—Case 1. White male, aged 25 years. *Control:* Colon capacity 2,000 c.c., retained. Motility and tonus decreased. Emptying time, 12 days. *Mecholyl:* 30 mg., five minutes, marked increase in tonus throughout colon; 10 minutes, tonus more marked and motility pronounced; 20 minutes, evacuation, haustrations are marked throughout; one hour, evacuation, shortening of long and transverse axes of colon; 24 hours, evacuation, haustrations are narrow and show irregularities in size, practically no barium in bowel.

Case 2. White male, aged 27 years. *Control:* Colon capacity 2,000 c.c., retained. Tonus normal; motility decreased. Emptying time, four days. *Mecholyl:* 30 mg., five minutes marked increase in tonus, haustrations irregular, decrease in size of rectum; 10 minutes, increased tonus, evacuation, shortening longitudinal axis of colon; 20 minutes, marked spasticity transverse colon, irregularity of cecum, rectum full; one hour, tonus of cecum increased, spasticity of transverse and descending colon; 24 hours, marked spasticity throughout colon, long axis has returned to original.

Case 6. White male, aged 27 years. *Control:* Colon capacity 2,000 c.c., retained. Tonus normal, motility decreased.

Emptying time, six days. *Mecholyl:* 30 mg., five minutes, increased number of haustrations in transverse and descending colon and in sigmoid; 10 minutes, same; 20 minutes, spasm in transverse and descending colon and sigmoid; one hour, evacuation, decrease in long and transverse axes of large bowel, spasm of cecum, ascending, transverse and descending colon, rectum contracted; 24 hours, evacuation, haustrations marked and irregular, entire colon spastic.

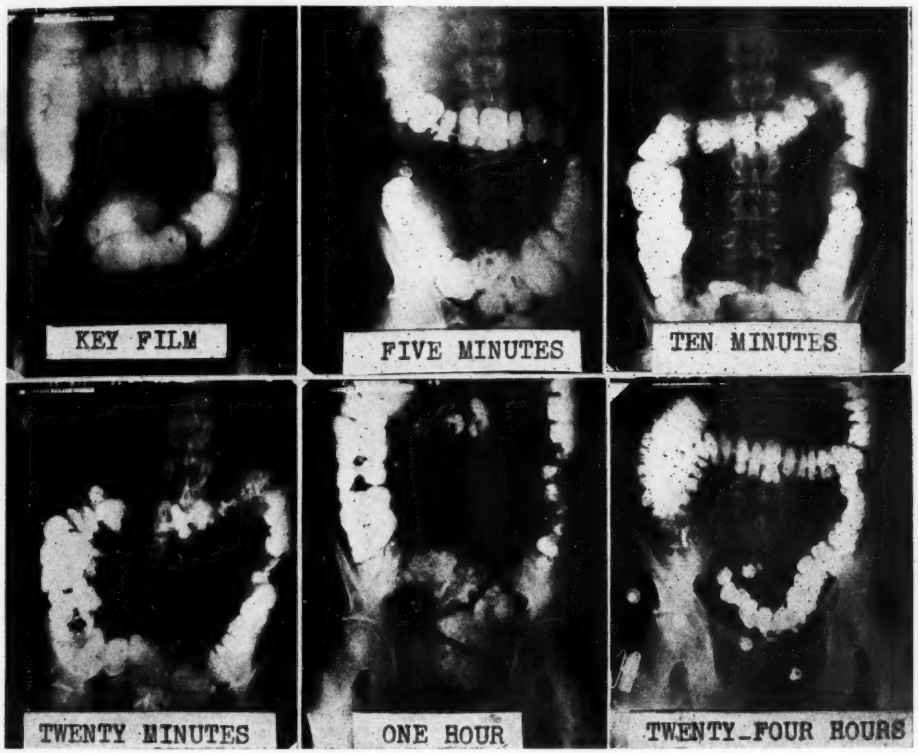


Fig. 2. Case 2. The key film shows an atonic, distended colon before the administration of mecholyl. After the administration of the drug, there is a marked increase in the tonus and the haustrations become deeper and more numerous. Areas of spasm are visible on the "ten minute" and subsequent films. At 24 hours, the colon is still hypertonic and contracted.

Case 7. White male, aged 25 years. *Control:* Colon capacity 2,000 c.c. Tonus and motility decreased. Emptying time, six days. *Mecholyl:* 30 mg., five minutes, evacuation; cecum smaller, ileo-cecal valve patent, irregular and deep haustral markings in transverse and descending colon; 10 minutes, same; 20 minutes, marked spasm of descending and sigmoid colon; one hour, evacuation, marked spasticity and irregularity of ascending and transverse colon, cecum small; 24 hours, entire colon empty.

Mecholyl and Atropine.—Case 10. White male, aged 33 years. *Control:* Colon capacity 2,000 c.c.; 1,950 c.c. retained. Tonus and motility decreased. Emptying time, eight days. *Mecholyl:* 30 mg., five minutes, haustrations marked particularly in descending and ascending colon; rectum appears smaller; 10 minutes, long and transverse axes of entire colon have de-

creased with increase in haustral markings, sigmoid spastic, rectum small; 20 minutes, entire colon spastic, much movement throughout, there is a definite desire to evacuate. *Atropine sulphate:* $^1/_{100}$ gr., five minutes, desire to evacuate has disappeared, cecum larger, rectum larger; 10 minutes, transverse colon definitely wider than before; 20 minutes, relaxation of entire bowel, no spasticity noted; 24 hours, much barium in colon, no evacuation.

Case 11. White male, aged 36 years. *Control:* Colon capacity 2,000 c.c.; 1,800 c.c. retained. Tonus and motility normal. Emptying time, four days. *Mecholyl:* 30 mg., five minutes, tonus of entire colon increased with definite decrease in transverse diameter, haustrations increased, definite increase in motility, at times the colon in portions seems to disappear; 10 minutes, cecum and rectum smaller, ileocecal valve patent, haustrations in ascending, transverse and descending colon marked, sigmoid spastic; 20 minutes, long and transverse diameters of colon decreased, desire to evacuate. *Atropine sulphate:* $^1/_{100}$ gr., five minutes, desire to evacuate less pronounced, cecum larger; 10 minutes, no desire to evacuate, rectum larger, haustrations less marked, long axis increased over original; 20 minutes, tonus has returned to normal although there are a few increased markings in transverse colon and splenic flexure, rectum and cecum dilated; 24 hours, colon has returned to its control state, much barium remains.

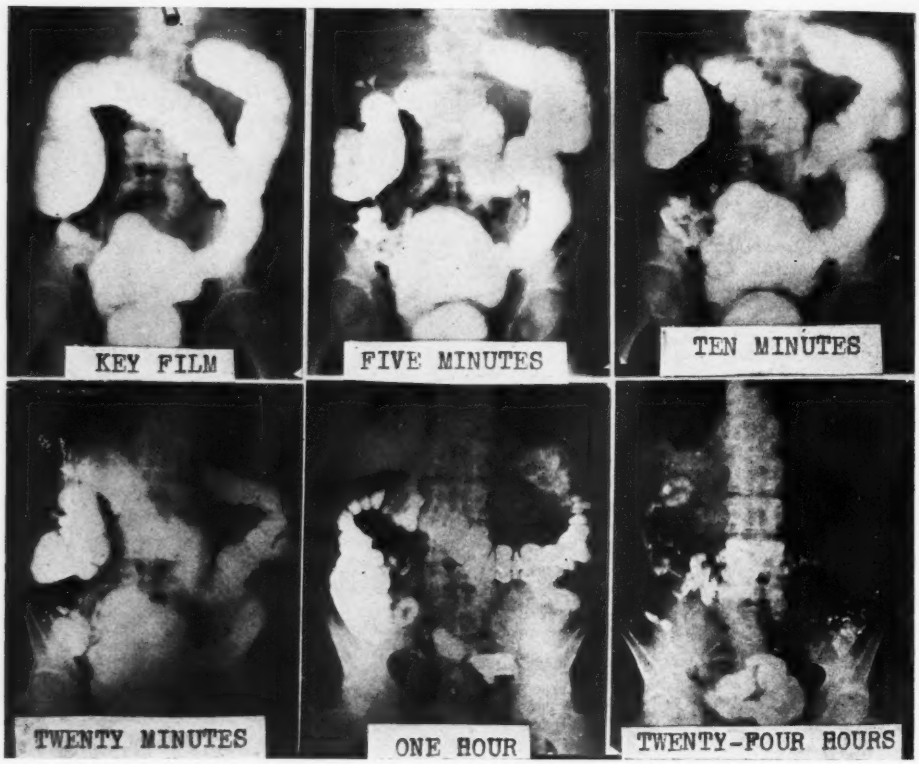


Fig. 3. Case 6. The key film shows the colon markedly atonic with almost complete absence of haustral markings; it required six days to empty the colon. After the injection of mecholyl, the colon shows a prompt and marked increase in tonus. The colon is practically empty 24 hours after the injection.

DISCUSSION

The observations presented in this paper lead to two specific conclusions, *i.e.*, (1) mecholyl increases the tonus of the colon to spasticity and at the same time increases the motility of the colon resulting in increased evacuation rate, *i.e.*, decreased emptying time; (2) atropine banishes any effects produced by mecholyl.

The tonus and, or, motility of the colon was not produced in an orderly or progressive manner. The onset of the action was rapid and at times violent. It attacked the entire colon so that while some part of it always appeared spastic, another showed rapidly fluctuating movement while another appeared entirely normal. In a moment this entire picture was changed but always on the side of increased tonus and motility. This speed and violence of change lasted several hours with a gradually progressive diminution, but the increase in tonus continued for at least 24 hours. In this respect the length of action of mecholyl on the colon was different from its other actions, for the rise in pulse rate, drop in blood pressure, salivation, rhinorrhea, lacrimation, flushing, and sweating were of short duration. The reason for this difference is at the present unknown.

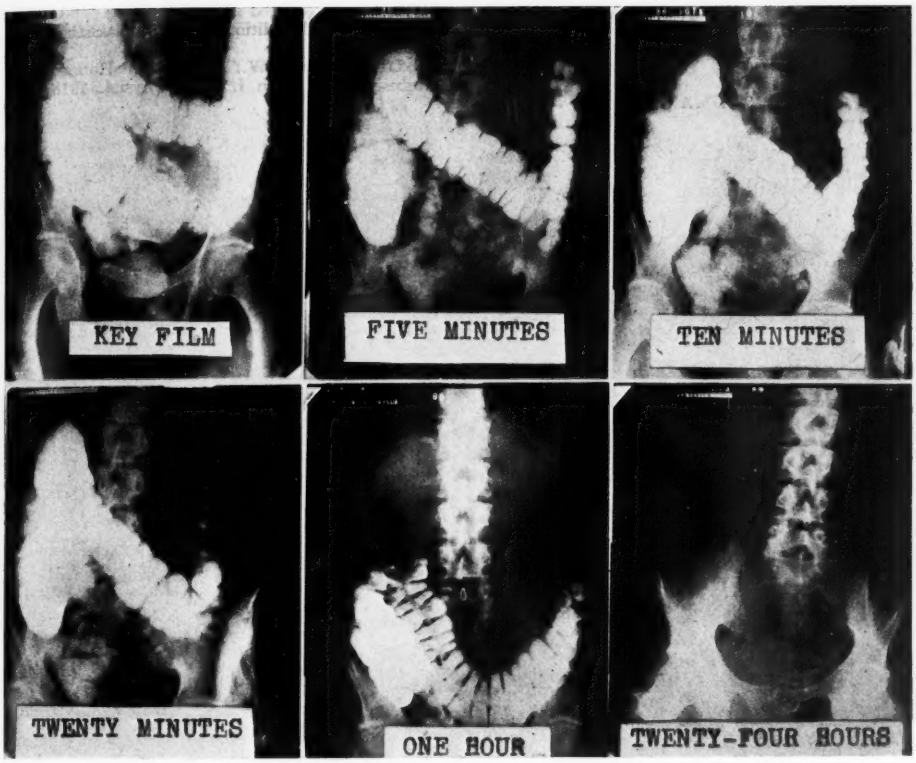


Fig. 4. Case 7. The colon before giving the mecholyl (key film) is markedly dilated and atonic. After the injection of the drug, there is a marked increase in tone. The "24-hour" film shows complete evacuation; prior to the injection, it required six days to empty the colon.

The mechanism of the action of the mecholyl upon the colon is in most all probability that of all of the cholines, *i.e.*, directly on the muscle cells.

Clinically, the drug is at the present of doubtful value in the treatment of atonic colons because of the unpleasant side reactions in all dosages wherein it has been used

by us to obtain therapeutic benefit. If the side reactions such as sweating, flushing, etc., could be eliminated by some subsequent modification of the drug, it is very possible that it could be used advantageously in the stimulation of the atonic colon.

SUMMARY

1. A study of the effect of mecholyl upon the tonus and motility of the colon is presented.

2. In every case the tonus and motility were definitely increased.

3. The effects of mecholyl upon the colon were abolished rapidly by atropine.

4. Mecholyl is of possible therapeutic value in the atonic colon.

BIBLIOGRAPHY

(1) WEILAND (quoted by Clark, A. J.): Applied Pharmacology, 4th Edition, p. 211. Blakiston's Son and Co., 1932.

(2) LE HEUX, J. W.: Cholin als Hormon der Darmbewegung. Arch. f. d. ges. Physiol., 1918, **173**, 8–27.

(3) LOEWI, O.: Über humorale Übertragbarkeit der Herznervenwirkung. I. Mitteilung. Pflüger's Arch. ges. Physiol., 1921, **189**, 239–242.

(4) ABBOTT, W. O.: Acetyl-*B*-methylcholine; Action on Gastro-intestinal Tract of Normal Persons, in Abdominal Distention, and in Certain Other Conditions. Am. Jour. Med. Sci., September, 1933, **186**, 323–330.

(5) COMROE, J. H., JR., and STARR, I., JR.: Pharmacology of Acetyl-*B*-methylcholine and Ethyl Ether of *B*-methylcholine; Further Studies. Jour. Pharm. and Exper. Ther., November, 1933, **49**, 283–299.

EXCRETORY UROGRAPHY[1]

By JOSEPH B. PRIESTLEY, M.D., F.R.C.S., *Des Moines, Iowa*

WITHIN recent years the advent of excretory urography has added valuable diagnostic procedure to the armamentarium of urologic diagnosis, which may occasionally supplant cystoscopy in the hands of one intimately acquainted with urologic pathology. However, for the vast majority of patients, cystoscopy, with or without retrograde pyelography, remains the most accurate and dependable diagnostic procedure. As in all diagnostic examinations, definite indications for excretory urography exist, certain technics add to efficiency, and certain pitfalls constantly lurk for the inexperienced.

I wish to discuss briefly the preparation of the patient, the indications, and then mention some of the limitations and dangers in interpretation, using a few illustrative cases as the basis of my remarks. Pyelographic interpretations will be discussed by Dr. Gillies and Dr. Kerr in the next paper. I shall omit special reference to children.

TECHNIC

To secure the maximum amount of information by excretory urography, roentgenograms free of gas shadows are essential. Therefore, from 30 to 45 c.c. of castor oil should replace the evening meal before the examination. In the morning, several enemas should be given and a light breakfast allowed. Restriction of fluid intake for several hours may increase contrast medium concentration. Some feel that a compression bag retards the escape of the medium down the ureter and so aids in concentration. Frequently it will tend to displace the colon so that gaseous shadows will not overlap the renal area. Recently, the intramuscular injection of pitressin 20 minutes before examination has been advocated. The urologist must be intimately acquainted with the patient's general condition in order to avoid certain contra-indications to pitressin, such as hypertension, intestinal obstruction, etc. My experience with pitressin to evacuate gas from the bowel has been limited. I do not use it routinely. Before administration of the medium, a roentgenogram of the kidneys, ureters, and bladder should be taken so that any faint shadows may be perceived before possible obscurity by the medium, and to determine before administration of the medium that preparation has been satisfactory. The medium ordinarily should be given in the median basilic vein, with moderate slowness. The patient neither sits up nor takes fluids without being so ordered. The first exposure should be made after an interval of five minutes, the next after 15 minutes. By examining the first roentgenogram before the second is taken, one may determine whether the second should be exposed earlier or later than the routine interval, depending upon the quantity of the medium in the bladder and the degree of renal visualization. In the presence of hydronephrosis or apparently non-functioning kidneys, one or more delayed roentgenograms ranging in time from one-half to two hours following the injection of the medium may give additional information. I have used neoiopax almost exclusively, and in my experience, which includes a large number of cases, local gangrene has never occurred. Moderately severe phlebitis occurred twice, but it subsided without complications under adequate treatment. The injection, especially when a small vein is used, may be accompanied by transient pain in the arm and shoulder and often a metallic taste in the mouth, but no severe systemic

[1] Presented before the Radiological Society of North America at the Twenty-second Annual Meeting, at Cincinnati, Nov. 30–Dec. 4, 1936.

reaction. There are few contra-indications to the administration of neo-iopax. More recently, I have employed diodrast, but my personal experience has not been adequate to draw conclusions. I have been impressed by the fact that the pain during the injection of diodrast seems less and the visualization appears equal to that obtained with neo-iopax.

INDICATIONS

The indications for excretory urography, generally speaking, are modified considerably by individual circumstances. I shall consider these indications, fully aware of the fact that many cases may also require retrograde pyelography and cystoscopy to establish the correct diagnosis and to obtain the necessary information. Eight main groups of cases will be discussed.

I. *Suspected renal or ureteral lithiasis* constitutes the most frequent indication for excretory urography.

Case 1. This patient, when seen, was suffering frequent attacks of renal colic, though his general condition otherwise appeared good. The plain roentgenogram shows a small shadow in the region of the upper ureter. The excretory urogram, taken 45 minutes after the administration of neo-iopax, discloses the same shadow, somewhat intensified by opaque medium, with pronounced urostasis above involving both the pelvis and calices. Medium in the distal ureter indicates incomplete obstruction. The visualization of the other kidney indicates no abnormality. Consequently ureterolithotomy was performed without a cystoscopic examination. His convalescence was uneventful.

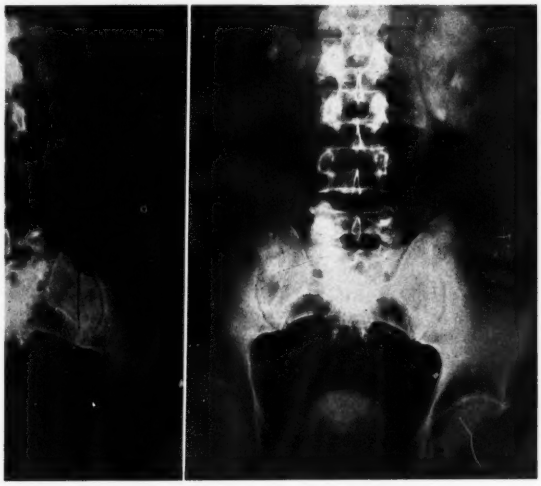
Case 2. In the case of an elderly man suffering from severe renal colic, there were seen three shadows on the plain roentgenogram. The excretory urogram disclosed two shadows in the lower major calix, with some caliectasis and pyelectasis which confirmed our suspicion that the remaining shadow was in the upper ureter. The diagnosis was established and treatment decided upon without resorting to retrograde pyelography. The patient was scheduled for ureterolithotomy. A roentgenogram taken in the morning before operation indicated that the stone had moved down to the middle of the ureter, and the operation was, therefore, abandoned. Instead, the ureteral stone was successfully removed by transureteral manipulation.

II. *Acute Abdomen.*—One sees two types of acute abdominal conditions in which excretory urography may be of distinct diagnostic aid by indicating whether or not urologic pathology explains the symptom.

(*a*) Red blood cells in a catheterized specimen of urine from a patient suspected of appendicitis should arouse suspicion. The symptoms of ureteral stone and appendicitis occasionally may be confusing. Case 3 represents such a patient. The diagnosis was confused by the discovery of red blood cells in a catheterized specimen of urine. An excretory urogram was made immediately. The plain roentgenogram shows this rounded shadow in the ureteral area. A urogram conclusively excludes the shadow because a normal urinary tract appears on the right side. Accordingly, I performed an appendectomy and removed a very acutely inflamed appendix. I wish to emphasize the fact that microscopic hematuria accompanying acute appendicitis occurs so rarely that the diagnosis of appendicitis with hematuria must always be looked upon with suspicion.

(*b*) At times an acute abdominal condition is associated with generalized abdominal pain or marked distention. Case 4 represents a patient whose condition was diagnosed as mesenteric thrombosis by the family physician (Figs. 1-*A* and 1-*B*). Close questioning elicited information suggesting renal colic at the onset. Here you see a shadow in the upper ureteral area which a delayed excretory urogram indicates to be a ureteral stone. Several days after the reflex abdominal ileus improved, this stone was removed, with complete recovery of the patient.

Cystoscopy was not necessary, the other kidney being well visualized and appearing normal.



A *B*

Fig. 1. Roentgenograms in the case of a man referred with the diagnosis of mesenteric thrombosis, presenting abdominal pain, distention, and vomiting. *A*, Plain roentgenogram showing shadow in region of left upper ureter. *B*, Excretory urogram showing caliectasis on same side above shadow. Left uretero-lithotomy: recovery.

III. *Hydronephrosis.* — Excretory urography is valuable in diagnosing hydronephrosis. Case 5 was a man 28 years of age, who had diabetes. His physician repeatedly found a small number of pus cells in the urine, but the patient complained of no urinary symptoms. These few eells were thought to be of no particular importance in the absence of symptoms, but an excretory urogram was advised (Fig. 2). You see a large functionless hydronephrotic kidney. A nephrectomy was performed because renal damage had proceeded too far for any conservative operation. The patient's convalescence was uneventful. Since then his urine has been examined repeatedly, and on one occasion mandelic acid therapy instituted because of persisting infection in the urinary tract. In hydronephrosis, roentgenograms taken within 20 minutes, and sometimes even longer, may show no medium, thus giving the impression of a functionless or absent kidney. However, a delayed film will usually reveal the true nature of the condition.

IV. *Mass in the Abdomen.*—Frequently a clinician finds himself confronted with an abdominal mass of somewhat uncertain etiology. Case 6 was a patient with a mass of undetermined nature in the region of the left kidney. An excretory urogram was advised to establish a definite diagnosis. As you see, the left kidney appears normal. The mass later proved to be a primary sarcoma of the spleen. Many horseshoe kidneys present a mass in the abdomen, often in the region of the navel. Occasionally an ectopic kidney presents a mass in the iliac fossa or elsewhere. When urologic possibilities are kept in mind for these unusual abdominal masses, an excretory urogram often points out the correct diagnosis even though retrograde cystoscopy may subsequently be necessary.

V. *Vague abdominal complaints* may have a genito-urinary origin. Occasionally renal stone manifests itself only by

reflex gastro-intestinal symptoms. Early stages of renal insufficiency from various causes may excite similar symptoms. Often the urologic symptoms of such patients are so meager that the physician hesitates to advise cystoscopy. However, an excretory urogram may be made to exclude the urinary tract. If one obtains positive evidence, then cystoscopy may be indicated.

Fig. 2. Excretory urogram in the case of a diabetic male, aged 24 years, with no urinary symptoms except persistent pyuria. Note large left hydronephrosis and right duplicated kidney. Left nephrectomy: recovery.

VI. *The Exclusion of Shadows.*—Occasionally during the roentgenologic examination of patients, shadows appear in the region of the kidneys or ureters. Although symptoms of calculus may be absent, the advisability of excluding the shadows often arises. An excretory urogram under such circumstances frequently excludes such shadows, and so one avoids cystoscopy. If positive, cystoscopy may or may not be indicated later.

VII. *Polycystic Kidney.*—In many patients with polycystic kidneys, palpation alone may establish the diagnosis with certainty: in other cases one may desire more definite information. Usually the excretory urogram will show extensive bilateral defects which clinch the diagnosis without further ado (Fig. 3).

Fig. 3. Excretory urogram confirming the diagnosis of polycystic kidneys. Note the pronounced bilateral deformity.

VIII. *Certain specific urologic conditions.*—Urologists treat many patients for (*a*) prostatitis. When a prostatic infection exists, the second glass specimen of urine may contain a few pus cells, coming either from the prostate or from the kidneys. In certain cases of this type, an excretory urogram may be used to great advantage to exclude possible renal pathology.

(*b*) An ecretory urogram proves of considerable value in certain post-operative conditions of the kidneys and ureters, as follows:

(1) *Impassable Ureteral Stricture.*—Case 7. This patient had had a hysterectomy performed some years before coming to me. Following the operation, urine drained from the wound for several months. She then developed pain in the renal area, with inter-

mittent chills and fever. I was unable to pass a catheter up the ureter, and, therefore, resorted to an excretory urogram for estimating the renal damage. You see (Fig. 4) a moderate hydronephyrosis resulting from a post-operative ureteral obstruction, which later demanded nephrectomy.

(2) *Post-operative Hydronephrosis.*—For moderate degrees of hydronephrosis various types of conservative operations are performed on the renal pelvis without sacrificing the kidney, such as the division of obstructing anomalous vessels, plastic procedures to decrease the size of the renal pelvis, and operations to place the uretero-pelvic juncture in a dependent position in the renal pelvis. The advisability of a post-operative check-up several months later arises, to determine one's result and the ability of the pelvis to empty. An excretory urogram serves this purpose well since it demonstrates varying degrees of hydronephrosis.

3. *Solitary Kidney.*—Not infrequently we encounter patients who have had a previous nephrectomy and now complain of symptoms referable to the remaining kidney. Under present conditions, retrograde pyelography seldom results in renal damage or reflex anuria; however, such things do occur occasionally. Consequently, in the presence of a solitary kidney we employ excretory urography, resorting to retrograde pyelography only in unusual instances.

(*c*) *Epitheliomatous Bladder.*—As a general rule, all patients with vesical tumors should have a biopsy made. When the biopsy reveals a squamous-cell epithelioma, one must then exclude the kidneys as a primary focus of the epithelioma. Excretory urography frequently can be employed very satisfactorily for this purpose.

(*d*) *Ruptured Kidney.*—Excretory urography for the diagnosis of ruptured kidney has been advocated. My personal experience with this has been too meager to warrant my drawing conclusions. It will, however, demonstrate the presence of a kidney on the uninjured side.

(*e*) *Suspected Congenital Anomalies.*—Occasionally a retrograde pyelogram shows the renal pelvis confined to the upper or lower half of the renal shadow, which arouses the suspicion of a duplicated pelvis. At times an excretory urogram may be of considerable aid in demonstrating the other pelvis. Frequently another retrograde pyelogram will be necessary. Since the advent of excretory urography, many duplications and anomalies have been discovered; such would have been unquestionably overlooked without it. However, this is in the main of anatomic interest mostly, but it does make us more alert to the possibility of pathology in various urologic anomalies.

Fig. 4. Excretory urogram in the case of a patient who underwent hysterectomy 12 years previously suffering left renal distress at intervals since. Note left hydronephrosis and ureterectasis. Ureteral catheter met an impassable obstruction in lower left ureter. Ureteral stricture resulting from surgical injury required nephrectomy: gallstone.

(*f*) *Renal Tuberculosis.*—At times the diagnosis of renal tuberculosis can be established by an excretory urogram, coupled with finding tubercle bacilli in the urine (Fig. 5). At other times

one may diagnose a renal tumor from an excretory urogram alone. However, these two types of cases do not present indications for an excretory urogram and should not be considered among this group. The same can be said for certain other rare conditions upon which I will not touch.

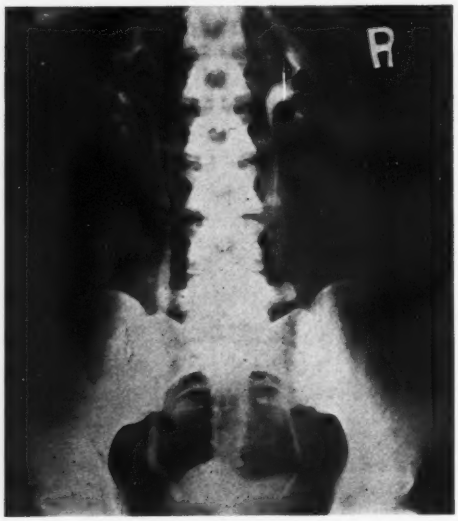


Fig. 5. Excretory urogram in the case of a patient suffering recurrent attacks of dysuria for three years. The left pyelogram strongly suggests renal tuberculosis. Tubercule bacilli were recovered from the bladder urine. Miscroscopic diagnosis of left kidney after removal was renal tuberculosis.

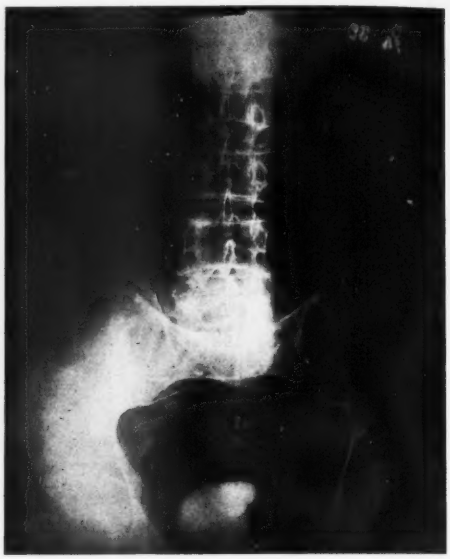


Fig. 6. Excretory urogram in the case of a male, aged 63 years, suffering gross hematuria. Excretory cystogram discloses defect suggesting bladder tumor. Biopsy obtained transurethrally revealed Grade III carcinoma.

DISCUSSION

To diagnose excretory urograms accurately, one must possess a sound knowledge of retrograde pyelographic interpretation. The absence of visualization, such as is often caused by stone, anomalies, etc., must not be interpreted as indicative of permanent renal damage. Incomplete filling of the normal renal pelvis should not be mistaken for disease. Excretory pyelograms should be employed only rarely for the diagnosis of inflammatory renal lesions.

Often when examining a patient by means of excretory urography, an excellent cystogram will be obtained, which may give considerable information. A primary cystogram should seldom be made in this manner. The patient in Case 8 complained of gross hematuria. The excretory cystogram showed a bladder defect suggestive of neoplasm (Fig. 6). This diagnosis was confirmed cystoscopically, and necessary treatment instituted. Not infrequently when an excretory urogram is made upon a patient with prostatic hypertrophy, one observes a marked intravesical enlargement of the prostate, shown by the excretory cystogram.

CONCLUSIONS

Excretory urography constitutes a valuable contribution to urologic diagnosis, but only occasionally supplants retrograde pyelography. Serious errors may occur in interpretations when the limitations are not realized or the indications too widely broadened.

1418 Des Moines Bldg.

THE ROENTGEN DIAGNOSIS OF LESIONS OF THE UPPER URINARY TRACT[1]

OBSERVATIONS ON 432 PATIENTS HAVING RETROGRADE PYELOGRAMS

By C. L. GILLIES, M.D., *and* H. D. KERR, M.D., *Iowa City, Iowa*

From the Department of Radiology, State University of Iowa College of Medicine

IN the roentgen diagnosis of lesions of the upper urinary tract, clinical and laboratory findings admittedly should be given full consideration. In practice, however, it at times is expedient to give a preliminary report of the radiographic examination before all data become available. It is, therefore, necessary that the radiologist be thoroughly familiar with the appearance of lesions likely to be encountered. Our purpose is to review the radiographic appearance of kidney lesions as revealed by retrograde pyelograms.

For this study we have selected 432 consecutive cases in which a pathologic diagnosis was made. These diagnoses were arrived at only after correlation of the clinical, laboratory, and radiographic examinations. Only adult patients on whom retrograde pyelograms were made are included in this series.

INFECTION

Infection heads the list in frequency of all lesions of the upper urinary tract. A diagnosis of pyelitis, pyelonephritis, or pyonephrosis was made 95 times in our series of 432 cases. In addition it sometimes complicates urinary calculi and hydronephrosis.

The age incidence of these patients varied from 18 to 66 years, the average being 40.7 years. It was found in women twice as often as in men and bilateral involvement was nearly twice as frequent as unilateral involvement.

In the mild or acute types of infection there may be no detectable changes in the pyelogram and it is necessary to make the diagnosis entirely by clinical and laboratory methods.

The more severe or longer standing infections present definite changes in the pyelogram. The first are noted in the calices, which lose their sharp outline and become dilated and clubbed. Infection also causes dilatation of the pelvis, which usually is not as marked as that due to obstruction. In long-standing or recurrent infection, the minor calices become elongated and show narrowed necks, the result of scarring. The calyx then is cone-shaped and its appearance is likened to that of a "dunce cap." The scarring also causes irregularity of the pelvis which, however, is not as marked with pyogenic infection as with tuberculosis (Fig. 1). Clubbing of some calices with narrowing of others is frequently present on the same pyelogram. Dilatation of the ureter often accompanies infection and was present in nearly one-half of our cases.

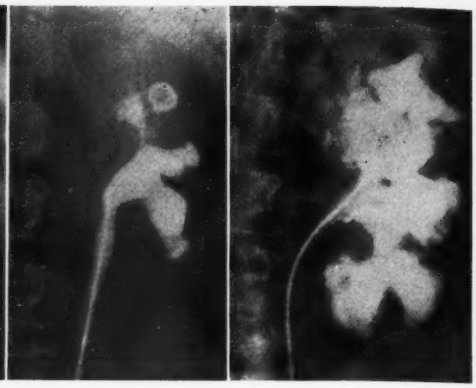
PERINEPHRITIC ABSCESS

In this series there were eight cases of perinephritic abscess: two occurred in conjunction with a pyonephrosis. As mentioned elsewhere, one followed traumatic rupture of the kidney; three were found complicating renal calculi, two ureteral calculi.

With perinephritic abscess, there is likely to be a loss of the psoas shadow on the involved side, with a scoliosis of the lumbar spine. The convexity of the curve is away from the involved side. There are no direct pyelographic changes unless, as sometimes occurs, the abscess communicates with the kidney pelvis. In such an event the abscess cavity becomes

[1] Read before the Radiological Society of North America at the Twenty-second Annual Meeting, at Cincinnati, Nov. 30–Dec. 4, 1936.

Fig. 1.



A *B*

Fig. 2.

Fig. 1. Chronic bilateral pyelonephritis. Note marked narrowing of major calices from scarring, clubbing of minor calices, and extensive kidney damage.

Fig. 2-*A*. Early tuberculosis. Abscess cavity in upper pole outlined by opaque medium. Upper minor calyx shows irregular outline. There is also extravasation of the opaque medium into parenchyma.

Fig. 2-*B*. Far advanced tuberculosis. Note marked irregularity of pelvis and calices and destruction of kidney substance.

outlined by the opaque medium, a finding which is characteristic of perinephritic abscess.

TUBERCULOSIS

A diagnosis of renal tuberculosis was made in 20 of the cases of this series, 14 occurring in men and six in women. The ages of the patients ranged from 20 to 54 years, the average age being 38 years. One patient showed a congenital anomaly, a duplication of the kidney pelvis and ureter on one side. Both kidneys, however, were involved with tuberculosis.

Calcification is frequently seen in renal tuberculosis and was present in nearly one-half of our cases. This calcification usually appears as a diffuse mottling and does not tend to occur in dense solid masses, therefore is not readily confused with calculi.

It was also observed that extravasation of the opaque medium as radiating striæ extending into the kidney parenchyma frequently occurred, being present in over one-third of the cases. While we are aware that similar extravasation may occur in a normal kidney from too forceful an injection of opaque fluid, such observations are rarely encountered in routine pyelograms.

The pyelograms in renal tuberculosis show a fairly characteristic appearance. The earliest radiographic changes are observed in one or two minor calices when the usual smooth outline is replaced by a rough "moth-eaten" contour. When a tuberculous abscess has broken through into the pelvis and discharged its contents, it may become well outlined by opaque medium (Fig. 2-*A*). If completely empty, these cavities may be smooth, but if some caseous débris remains the outline is irregular. In more advanced cases, the pelvis and calices are involved in their entirety and show marked irregularity of outline. In addition, there may be numerous abscesses within the kidney parenchyma communicating with the pelvis.

In advanced cases, secondary involvement of the ureter is common. This manifests itself as an irregular narrowing which may give partial or complete obstruction, resulting in a tuberculous pyonephrosis. In the pyelogram this is observed as a marked dilatation of the pelvis and calices, with destruction of the kidney substance (Fig. 2-*B*). There is, in addi-

Fig. 3.

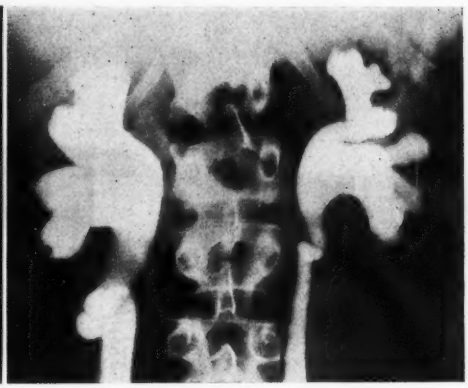


Fig. 4.

Fig. 3. Autonephrectomy from advanced tuberculosis. In this type, the tubercles do not empty into the pelvis but become calcified—the so-called "putty kidney."
Fig. 4. Bilateral hydronephrosis. Note uniform smooth dilatation of pelves, calices, and ureters. The cupping of the minor calices has been lost.

tion, a marked irregularity of the pelvic outline.

In some instances the entire kidney is replaced by large caseous tubercles which have failed to drain into the kidney pelvis. These then become partially calcified so that the individual tubercles are well outlined on the radiographic film (Fig. 3). The so-called "autonephrectomy" is the result of this type of tuberculous infection. When such a kidney is sectioned, it is of putty-like consistency and shows complete replacement of the kidney parenchyma by caseating tubercles.

HYDRONEPHROSIS

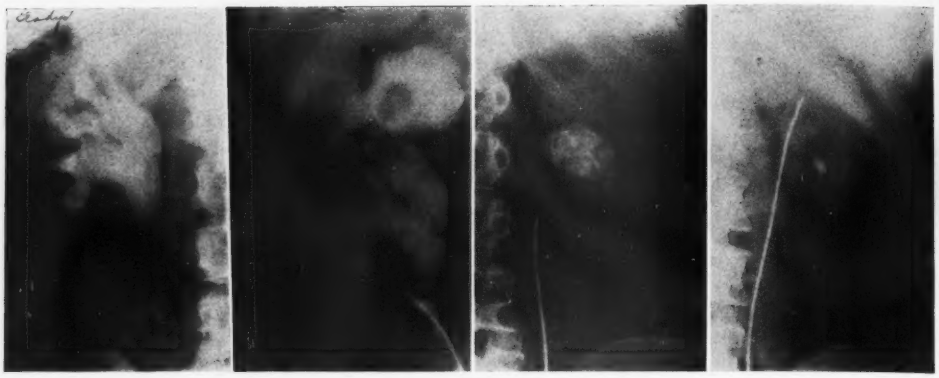
Next to infection, hydronephrosis is the most frequent lesion of the upper urinary tract and was found in 79 of our patients. It occurs in varying degrees but is much more common as a mild form. In only six of our cases was the disease advanced, while in 18 it was considered moderately advanced. Women were affected in more than two-thirds of our cases. The left kidney alone was involved in only about 10 per cent; in more than one-third it was bilateral, while the right kidney alone was affected in more than 50 per cent of the cases.

The condition begins as a mild dilatation of the kidney pelvis and may early show some blunting of the minor calices, although occasionally one finds a moderate degree of involvement of the major and minor calices without accompanying pelvic enlargement. As the disease progresses, the minor calices become more globose and expand at the expense of the parenchyma (Fig. 4). Ureteral dilatation is a concomitant of hydronephrosis when the obstruction is low and was found in more than one-half of our cases.

The presence or absence of infection of the hydronephrosis cannot be determined radiologically even though the infection be marked.

PTOSIS

Movable or ptotic kidney is not uncommon and was diagnosed 18 times in our 432 cases. It is usually accompanied by a mild degree of hydronephrosis, although in five of the 18 cases there was no dilatation of the pelvis. The appearance of the hydronephrosis does not distinguish it from that without ptosis. The ptotic kidney should not be confused with the congenitally unascended kidney. In the former the ureter is long and redundant when the kidney is displaced downward, while in the latter the ureter is relatively short and straight, and the kidney shows a lack of normal rotation.



A *B* *A* *B*

Fig. 5. Fig. 6.

Fig. 5-*A*. Plain film showing branching calculus filling entire pelvis and calices.
Fig. 5-*B*. Pyelogram shows in addition a large abscess cavity in upper pole of kidney.
Fig. 6-*A*. Multiple faceted calculi.
Fig. 6-*B*. Single small stone in lower kidney pole. Pyelogram was normal.

RENAL CALCULUS

Stone in the kidney is a relatively frequent occurrence and was present in 73 cases of our series.[2] These stones may be single, multiple, or of the branching or so-called "staghorn" variety (Figs. 5 and 6). Men are usually reported as being more frequently affected than women, but in our cases there were 40 women as against 33 men.

Single stones are most common. They show as uniform areas of calcification, varying in size from a few millimeters to several centimeters and are seen to lie within the kidney shadow. They are usually completely obscured by the injection of the pyelographic material; occasionally, however, a stone will contain no calcium. Such a calculus can then be demonstrated only on the opaque pyelogram as a shadow of negative density or a filling defect. The use of air as a pyelographic medium may clearly outline this type of stone.

Renal calculi are usually uniform in density, without visible laminations, and rarely does one find faceted stones. Only one such case appears in our series.

In our 73 cases, there was involvement of 85 individual kidneys. The finding was more than twice as frequent on the left side as on the right, and while the single stone predominated, the staghorn type was present in almost 25 per cent of the cases. Ureteral calculi were seen as a complication of renal stones in a minority of cases (nine times), and when found were noted to be on the opposite side as frequently as on the side of the kidney stone.

In nearly every case of multiple or staghorn stone, kidney damage was observed, while with single calculus this occurred only in about half of the cases. This damage may show as an involvement of a single calyx with slight dilatation and roughening, or it may progress through varying stages until, because of gross stasis and infection, it becomes a marked pyonephrosis. This may then go on to the formation of a perinephritic abscess, which was present in three of our cases. The staghorn stone is most frequently associated with this advanced renal damage.

URETERAL CALCULUS

In addition to the nine patients previously mentioned, in which kidney and

[2] Ten cases of renal calculi occurring in this series have not been included in these figures because they were found together with other lesions which in themselves were considered primary, *i.e.*, three in duplex kidney, one in crossed ectopia, and six in hydronephrosis due to aberrant blood vessels.

A

B

Fig. 7.

A

B

Fig. 8.

Fig. 7-*A*. Large oval calculus in upper ureter. Known to have been present for one year.
Fig. 7-*B*. Pyelogram seven months after removal shows remarkably few changes.
Fig. 8-*A*. Hypernephroma demonstrating elongated, compressed, and displaced calices. The tumor has not invaded the pelvis.
Fig. 8-*B*. Papillary carcinoma of kidney pelvis showing irregular filling of pelvis with neoplastic tissue.

ureteral calculi occurred together, there were 42 cases of this series in which ureteral calculi were present alone. In 40 instances a single stone was present on one side. Only one case showed a stone on each side and in only one instance were there multiple stones in one ureter.

Calculi occurred with nearly equal frequency in men and in women. The left side was involved over a third more often than the right.

These calculi are usually oval in shape, with the long axis of the stone lying in the long axis of the ureter. The most frequent site is at the lower end of the ureter near the ureteral opening into the bladder. They vary in size from a few millimeters to two or three centimeters in length. Usually they are of rather high calcium content and of fairly uniform density although some show definite laminations.

Some degree of ureteral dilatation is also frequently present and may be either above or below the calculus.

In the presence of ureteral stone, a large percentage of the pyelograms show pathologic changes—the result of obstruction, accompanying infection, or a combination of both.

The presence of a ureteral stone, however, does not necessarily mean that kidney damage has occurred, as a very large calculus may be present with little or no evidence of kidney pathology (Fig. 7). On the other hand, very definite changes may be produced by a rather small calculus.

Perinephritic abscess may be a complication and was present in two of our cases.

MALIGNANT NEOPLASMS

Malignant neoplasm was diagnosed in 24 cases, 15 times in men and nine in women. The patients' ages varied from 43 to 70 years, the average age being 56.4 years. The right side was involved as frequently as the left and no case was bilateral, although bilateral involvement has been known to occur. In nine of the 24 cases, a pathologic diagnosis was obtained. Following Ewing's classification, these were diagnosed as follows:

(1)	Adenocarcinoma	4
(2)	Papillary carcinoma of the kidney pelvis	1
(3)	Hypernephroma	4

From a radiographic standpoint, malignant kidney tumors can conveniently be divided into two groups, those arising in the kidney parenchyma and those arising from the kidney pelvis.

In malignant neoplasms of the kidney

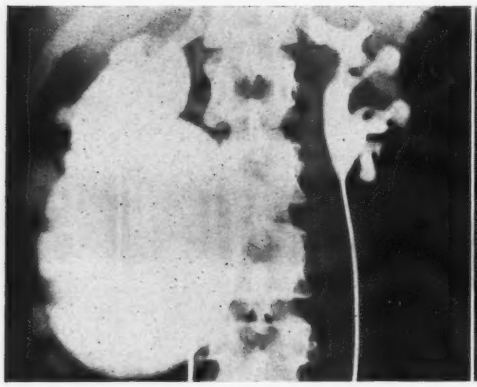


Fig. 9.

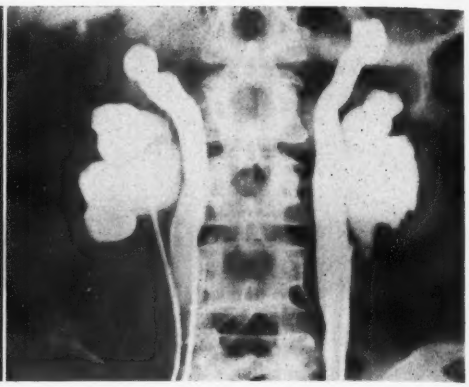


Fig. 10.

Fig. 9. Advanced hydronephrosis due to aberrant blood vessels. Note rounding of all contours with extreme dilatation of pelvis.

Fig. 10. Duplex kidneys and ureters, bilateral, with moderate hydronephrosis and hydroureter. This is the most common congenital anomaly.

parenchyma the tumor mass itself may be visible on the radiograph, showing either as a distortion of outline or as an increase in density. In the larger tumors the kidney is likely to be obviously displaced from its normal position.

As the tumor grows it not only distorts the parenchymal outline but the kidney pelvis and calices as well (Fig. 8-*A*). The calices are frequently elongated and narrowed by the general enlargement of the kidney, producing the so-called "spider leg" deformity. The calices may become displaced, compressed, or even completely occluded. Some malignancies of the parenchyma may invade the pelvis, producing filling defects in the pyelogram, in which instance it may be impossible to distinguish neoplasms of the parenchyma from those arising from the pelvis. Not infrequently the pelvis may become completely occluded so that it is impossible to obtain a pyelogram.

Diffuse and scattered calcification sometimes occurs within kidney malignancies. While not present in this series, calcification was observed three times in another series of 23 cases that we had opportunity to study.

Tumors arising from the epithelial lining of the kidney pelvis are usually papillary and, therefore, cause an irregular filling defect in the pyelogram (Fig. 8-*B*). There is no distortion of the pelvic outline until occlusion of some of the calices occurs, in which instance a localized hydronephrosis may develop. These tumors are prone to metastasize along the ureter with resulting obstruction. Radiographically, it may at times be impossible to differentiate tumors of the kidney pelvis from blood clots, non-opaque calculi, or masses of cellular débris.

Benign tumors of the kidney and kidney pelvis are not common and are rarely diagnosed except at operation or postmortem examination.

CONGENITAL ANOMALIES

Hydronephrosis Due to Aberrant Blood Vessels.—Aberrant blood vessels to the lower pole of the kidney, with constriction of the uretero-pelvic junction and hydronephrosis, were diagnosed in 38 of our 432 cases. Such constitute, therefore, a relatively common lesion.

The pyelographic changes are fairly characteristic. In mild types there is a squaring of the kidney pelvis noted, particularly at the uretero-pelvic junction, where the aberrant vessel crosses the ureter, causing it to be narrowed and fixed at the

Fig. 11.

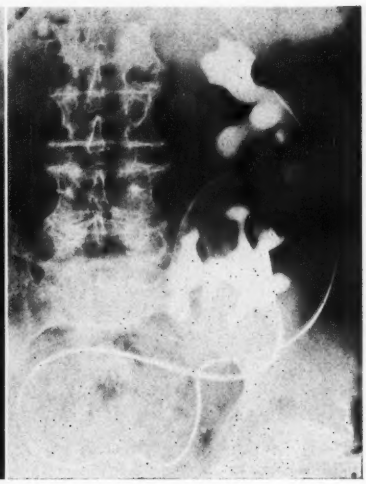


Fig. 12.

Fig. 11. Horseshoe kidney. Failure of complete rotation with fusion of the lower poles.
Fig. 12. Crossed ectopia. Both kidneys on one side, show apparent fusion with incomplete rotation and ascent.

same level or slightly above the lower margin of the dilated pelvis. The medial and inferior borders of the kidney pelvis are then nearly at right-angles to each other instead of forming the inverted cone of the normal uretero-pelvic junction. As further dilatation of the pelvis occurs it overhangs the attachment of the ureter so that in advanced cases the uretero-pelvic junction lies several centimeters above the lower margin of the kidney pelvis. The calices take part in the general dilatation so that in more advanced cases the pelvis has a plump oval appearance, with dilated rounded calices (Fig. 9). The outline is composed of gentle curves with an almost total lack of angles except at the attachment of the ureter, which is angled sharply over the aberrant vessel. This usually crosses in front although it may cross behind the ureter.

In cases with marked hydronephrosis, infection is frequently present. Six cases in this series were also complicated by calculi and one patient had a duplex kidney and ureter on the opposite side.

Anomalies of Form and Position.—The most common congenital anomaly of the upper urinary tract is a reduplication of the kidney pelvis. This deformity ranges from slight variations, in which the pelvis is bifid, to complete reduplication of the pelvis and ureters. Included in this series are only those cases showing complete reduplication of the pelvis, together with a partial or complete reduplication of the ureters. There were 22 patients in this group, six men and 16 women. The right side was involved ten times and the left nine. Three cases were bilateral (Fig. 10).

If the ureteral catheter is introduced into the ureter leading to the upper pelvis, the diagnosis can usually be suspected from the small lily-like pelvis which, if the kidney outline is visible, is obviously too small for the size of the kidney. If the lower pelvis alone is visualized, this usually is of nearly normal size and appearance and the anomaly may be readily overlooked. Should both pelves be visualized either by double catheterization or by reflux in a partially reduplicated ureter, the diagnosis is, of course, obvious.[3]

Horseshoe kidneys were present in four patients, three men and one woman. In good films a bridge of renal tissue can be seen extending across the spine from one

[3] In addition to the 22 patients of this group, one case was complicated by tuberculosis (*q.v.*) and one by hydronephrosis, due to an aberrant blood vessel (*q.v.*) on the opposite side.

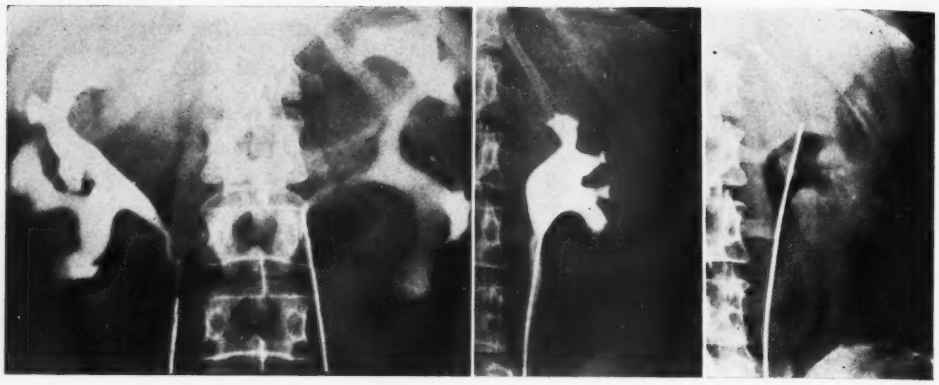


Fig. 13. A Fig. 14. B

Fig. 13. Polycystic kidneys. Marked elongation and separation of calices with sharp, clear-cut outlines.
Fig. 14-*A*. Cellular débris. Opaque pyelogram shows mild hydronephrosis with ill-defined filling defect.
Fig. 14-*B*. Air pyelogram shows mass of cellular débris which cannot be distinguished from a non-opaque calculus.

kidney to the other, producing the horseshoe shape from which this anomaly derives its name. The most characteristic feature, however, is seen on the pyelograms. These kidneys fail to rotate normally as they ascend from the pelvis during development, so that the calices remain posterior and are superimposed or lie to either side of the renal pelvis in the pyelogram instead of being located laterally as in normal kidneys (Fig. 11).

An unascended and unrotated kidney was present in each of two patients, the other kidney occupying a normal position. These are distinguished from a ptosed kidney by the short ureter that is present, together with the disturbed directional relationship of the pelvis and calices, the latter being usually located posteriorly. With ptosis, the ureter is of normal length and when dropping occurs it becomes tortuous. There is also likely to be some rotation of the kidney so that the calices are inferior to the pelvis.

Crossed ectopia is a rare anomaly and was present in only one case (Fig. 12), both kidneys lying on the left side, with the right kidney below the left and apparently fused to it. The ureter entered the bladder at its normal location but curved upward and to the left to reach the mal-positioned kidney.

Congenital absence of one kidney is also rare and is said to occur about once in every thousand individuals. It was present in only one patient in this series.

Kidney calculi were present in ten out of 68 patients with congenital anomalies, four in patients with anomalies of form and position, and six in patients with hydronephrosis due to aberrant blood vessels.

Polycystic Kidney.—Polycystic kidneys are not common and were present in only four cases of this series—three women and one man. Their ages varied from 38 to 51 years, the average being 43.75 years. All showed bilateral involvement.

The pyelograms usually show the pelves and calices to be elongated, narrowed, and widely separated (Fig. 13). Even though there may be marked deformity of the pyelogram, the contours are clear-cut with normal cupping of the minor calices. Rounded filling defects from marginal cysts are frequently present.

The fact that both kidneys are usually involved to the same extent and have pyelograms of similar appearance is also an aid in making the diagnosis of polycystic disease.

MISCELLANEOUS

Cellular Débris.—One patient showed a filling defect in the opaque pyelogram,

confirmed by air pyelograms, which on pathologic examination was found to be a putty-like mass of cellular débris (Fig. 14),

Cyst.—A diagnosis of a simple cyst of the kidney was made in one patient, a woman 44 years old. These cysts usually

A *B*

Fig. 15.

Fig. 15-*A*. Retroperitoneal metastasis from teratoma of testis. Kidney and ureter are markedly displaced and distorted.
Fig. 15-*B*. Perinephritic abscess following traumatic rupture of kidney.

the kidney pelvis showing metaplasia of the epithelium. This was diagnosed preoperatively as a non-opaque calculus and even in retrospect shows no differentiating characteristics.

Retroperitoneal Tumors.—The pyelograms in two of our cases showed marked deformity and displacement of the kidney due to retroperitoneal metastases from a teratoma of the testicle (Fig. 15-*A*). These tumors frequently metastasize to the retroperitoneal lymph nodes, which may become so large as to occlude the ureter or displace the kidney and ureter. The pyelograms themselves are not characteristic.

Rupture of the Kidney.—There was one case of ruptured kidney (Fig. 15-*B*) occurring in a man 38 years old who fell from a height, striking on his left side. The pyelogram taken three weeks later showed extravasation of the opaque medium through the ruptured tissue into a perinephritic abscess.

attain a large size before being discovered and can then often be seen attached to the kidney. Because of the large size of the cyst the kidney is likely to be displaced, yet, as in our case, there may be no deformity of the kidney pelvis. At times, however, there may be flattening of the calices from pressure.

SUMMARY

A review has been made of the pyelographic findings in 432 consecutive patients having lesions of the urinary tract.

In this series infection was found most often, followed by hydronephrosis, renal calculus, congenital anomalies, ureteral calculus, neoplasms, and tuberculosis—in order of decreasing frequency.

Aside from these main groups a few scattered cases, such as retroperitoneal tumor, ruptured kidney, simple cyst, and cellular débris, were encountered. The various groups of kidney lesions have been

analyzed and the pyelographic findings described.

TABLE I.—INFECTION

Total cases	95	Average age	40.7
Males	33	Right side	19
Females	62	Left side	13
Oldest	66	Bilateral	63
Youngest	18	Ureteral involvement	44

TABLE II.—TUBERCULOSIS

Total cases	20	Right side	6
Males	14	Left side	5
Females	6	Bilateral	9
Oldest	54	Calcification	8
Youngest	20	Extravasation	7
Average age	38	"Putty kidney"	1

TABLE III.—HYDRONEPHROSIS

Total cases	79	Average age	38.3
Males	24	Right side	43
Females	55	Left side	8
Oldest	74	Bilateral	28
Youngest	16	With dilated ureters	59

TABLE IV.—RENAL CALCULUS

Total cases	73	Left side	39
Males	33	Bilateral	12
Females	40	Total involved kidneys	85
Oldest	77	Single stones	50
Youngest	20	Multiple stones	16
Average age	44.8	Staghorn	19
Right side	22	With ureteral stone	9

TABLE V.—URETERAL CALCULUS

Total cases	42	Left side	24
Males	22	Bilateral	1
Females	20	Multiple unilateral	1
Oldest	69	Kidney damage	32
Youngest	23	Upper half ureter	15
Average age	43.1	Lower half ureter	27
Right side	17		

TABLE VI.—ABERRANT VESSEL HYDRONEPHROSIS

Total cases	38	Average age	36.7
Males	18	Right side	14
Females	20	Left side	6
Oldest	66	Bilateral	18
Youngest	19	With renal stone	6

DISCUSSION

DR. BERNARD H. NICHOLS (Cleveland, Ohio): It is always valuable to have the experience of a urologist in making a diagnosis from a pyelogram because the quantity of retained urine, the presence of obstruction to the catheter, or reproduction of pain cannot be determined by the films. It often becomes necessary, however, after intravenous urography to give an opinion without the counsel of the urologist.

Many cases now are not referred to the urologist until after the preliminary examination has been made, and a suspected lesion has been found in the urinary tract.

I would like to stress the importance of good stereoscopic films before any opaque medium is introduced. This will be of value in many cases in which there are no definite symptoms referable to the urinary tract. Such examinations may show the presence of a tumor or a large kidney due to hydronephrosis, neither of which may cause urinary symptoms, pain perhaps being the only complaint. This should be preliminary to all complete investigations of the gastro-intestinal tract. A stone may be found in the kidney which is producing a spastic colon, and this would be missed completely if the examination were made after the administration of barium.

A plain film of the kidneys, ureters, and bladder may show a rounded mass connected with the kidney, and if this examination is followed by an intravenous urogram, a solitary cyst or tumor may be determined as the cause of this deformity. However, such a diagnosis should be only tentative and the final decision should rest with the urologist.

I cannot quite agree with Dr. Gillies on the limitations of intravenous urography. In our experience this procedure can be used satisfactorily in a considerably larger field than he has indicated.

The urologist usually can secure better visualization of kidney lesions by retrograde pyelography, and the procedure is justified, but a large group of cases will still be left to the roentgenologist for interpretation and this will have to be done by the intravenous method.

We have been very much disappointed in the use of catharsis and enemas as a routine procedure. We feel that there is marked increase of gas after castor oil, and that the patients are best examined without any medication. If gas or the

intestinal contents obscure visualization of the urinary tract, pitressin may be administered. This has been found satisfactory in the removal of gas and any other obstructing material in the bowel.

I would also caution you about the interpretation of intravenous pyelograms done immediately after catheterization of the ureters. Such ureters often are irritated, and spasm will give a false appearance of retention in one or both kidneys.

Although the beautiful pyelograms shown by Dr. Priestley and Dr. Gillies demonstrate the correct diagnosis of these lesions, it cannot be questioned but that additional information could be obtained in some of these cases by an intravenous examination which would show the promptness of function and the presence or absence of retention of urine. This applies particularly to cases of ptosis and rotation—in fact, to most cases in which there is a lesion of the kidney. Our routine is to make one film immediately after the injection to determine the thrust excretion, and this is followed by a film in fifteen minutes, one in one-half hour, and one in one hour after the injection. In cases of poor function additional films may be made later, the time to be determined by the findings on the first four films.

Dr. Gillies' films are beautiful, and I would like to inquire what type of medium he uses for his pyelograms.

A helpful point in the diagnosis of tuberculous lesion of the kidney is that this lesion usually is localized at first, then extends entirely around the pelvis, leaving a continuous cavitation without fragmentation by local cortical abscesses as seen in other types of infection. Ureteral involvement also usually will make such a diagnosis certain.

A tumor of the kidney may often be very well outlined by the intravenous method; however, this will often have to be confirmed by a retrograde examination, and this should always be borne in mind if there is any doubt about the diagnosis.

We dislike compression of the ureters, but it may be done by placing a soft rolled bandage over each sacro-iliac region and a compression band across the abdomen, thus producing a temporary retention which will outline the kidney pelvis well. The density of the shadow of the kidney pelvis may be increased by dividing the intravenous dose, giving one-half at the beginning and the other half in 15 minutes. We have found the best visualization occurs in 15 minutes and that an additional thrust excretion at this time will add to the density of the shadow.

I agree with Dr. Gillies about the possibility of determining the presence of a horseshoe kidney as well as other anomalies by intravenous pyelography. This is true in many cases and it is particularly helpful in duplex kidney in which the duplication of the ureters does not extend to the bladder. In such instances only one ureter may be visualized by the catheter and the other missed, while with the intravenous method, both portions of the pelvis will usually be shown and in many instances the double ureter also.

DR. CARL L. GILLIES (closing): Dr. Nichols asked what we used as a medium. Of course, I am not the urologist, but I do know that sodium iodide was used in these pyelograms which I have shown.

As far as the intravenous pyelograms go, I feel there is a definite place for intravenous pyelography. I am not a champion of retrograde pyelography at all. The reason I showed only retrograde pyelograms is because I was requested to talk upon retrograde pyelograms.

HEREDITARY DEFORMING CHONDRODYSPLASIA

By REUBEN G. ALLEY, M.D., *Pittsburgh, Pa.*

From the Diagnostic X-ray Department of The Western Pennsylvania Hospital

UNDER the general heading of dyschondroplasia a number of variants are described: some are given separate names and described as clinical entities, yet the dividing line is not clean-cut and cases may be seen that show changes ascribed to more than one type. When the family here reported first came to our notice, the initial problem was accurate classification and therein we found a maze of synonyms and interrelated terms. As criteria for each were analyzed, it was found that every characteristic could be demonstrated in one or more cases, though in varying prominence. Some had a tendency toward exostosis, others revealed more enchondroma. Another had numerous tiny dense stippled areas that on first glance resembled ostiopoikilosis, but films made with a different projection showed them to be in the soft tissue overlying the bones rather than in them. From a study of this family we are prepared to agree with an opinion that many of these cases of disturbed bone growth are transitional phases between a single exostosis at one extremity and a fully developed hereditary, deforming chondrodysplasia at the other. After reading descriptions and discussions of related terms—Ollier's disease, hereditary multiple exostotis, diaphyseal aclasis, hereditary multiple enchondroma, multiple cartilaginous exostoses, and hereditary deforming chondrodysplasia—we decided upon the latter as more liberal and all-embracing, and so classified these cases.

The first patient seen by us was George, aged 12 years, who is No. 4 in our series. He was injured by an automobile and sent to the hospital with a fractured tibia. After seeing the bone conformation of his leg, the other long bones were also roentgenographed. During the examination he volunteered the information that several

Fig. 1. Wrists and forearms of five children in the order of their ages. Ulnar shortening and bending are present in all but the youngest. Trumpeting of diaphyseal ends of long bones, decreased density with coarse striations, and exostoses of varying sizes are also noted.

Fig. 2. Lower leg films are also characteristic. Exostoses slightly more marked, especially at proximal ends of fibulae.

brothers and sisters also had "lumpy legs and arms." Due to the kindness of their family physician we were able to examine the parents and five children.

The father and mother were free from bony abnormality. Unfortunately, their family history cannot be considered accurate. Each parent looked askance at the other and assured me, "Nobody like that in *my* family!" It was all too evident that it would never be admitted by either, regardless of fact. An added difficulty was the circumstance that relatives of both live in Jugo-Slavia and no check can be made.

The family history is not extensive as there were language difficulties as well as only limited co-operation on the part of the parents. Both were born in Austria, but not related. There had been fourteen pregnancies with seven living children. Two girls of 17 and 14 years, respectively, are perfectly normal and may be described as "fat and rosy." The affected children are sallow, underweight, and inclined to be short in stature. This is more outstanding in the two older children, and superficial deformities are noted in three. Only the x-ray films revealed pathology in the two younger ones.

The mother tells us that the two normal girls were breast-fed until a year old, while all others, except the baby, were put on the bottle in a month or two and given no supplementary feedings of fruit juice or fish oil. The youngest was breast-fed for a year and has been fed fruit juice. Her films are included in this series because she is under the age when lesions first were noted in the other children, and because one foot shows changes we consider questionable (Fig. 3-*A*). All of the children are described as being normal until after three, when "lumps" begin to appear. Nick (B), who is eight, has very little superficial deformity, though the roentgen changes are typical. No disability is complained of by the children.

They are attending school, each is in his or her proper grade, and none has been required to repeat a year's work.

In him, enchondromal development is more marked than the exostoses. He is the only one who shows the small round

Fig. 3. The phalanges and metatarsals are not greatly deformed but small enchondromas are present in all and surface deformity is quite marked in the two older boys.

The only blood work done was on the original patient. His blood calcium was 10.3 mgm., phosphorus 5.1 mgm., and Kahn test negative. The following blood count was done on admission: red blood cells, 4,901,000; white blood cells, 24,150; hemoglobin, 80–90 per cent; polymorphonuclears, 86 per cent; large lymphocytes, 2 per cent; mononuclears, 2 per cent; small lymphocytes 2 per cent; transitionals, 4 per cent; eosinophiles, 2 per cent; basophiles, 2 per cent.

As these cases show progressive development of the disease, we have arranged the films in chronological order for a better comparison of the lesions. Martha (A), who is 3 years of age, is first on all of the films and, reading from left to right, the others are Nick (B), aged 8; Mary (C), aged 10; George (D), aged 12, and Walter (E), aged 16.

Martha, as has been said, may belong in the class of normals—only time can decide that—but we feel that there is a small projection on the proximal phalanx of her right first toe (Fig. 3-*A*) and slight irregularity of the metatarsal epiphysis. Otherwise she appears normal and there is no delay in the ossification of her epiphyses.

Nicholas has early lesions about equally developed on the right and left. The wrist and knee show characteristic changes. areas of increased density in the wrist (Fig. 4-*B*). These are not in the already formed bones but can be shown as separate shadows when films are projected in other planes. Islands of dense calcification are reported in older cases of Ollier's disease, but this is the youngest definite case, and the calcification is not intraosteal.

Mary has a greater tendency toward exostosis formation and her right side is more involved than the left, with the possible exception of the wrists. Chondromas are present in the wrist but there are very slight changes in the hand. Exostoses may be seen at ends of all long bones as well as in the mid-shaft of the humerus.

George, on the other hand, demonstrates an almost typical picture of that described for hereditary, deforming chondrodysplasia. There is widening of the metaphyseal ends of the long bones and longitudinal coarse striations, with areas of decreased density between them. The shortening and bowing of the ulna and fibula are very marked, with typical wrist and knee deformity. Simple chondromas are present in the phalanges, but are infrequent.

Walter has more marked shortening of the shaft, increased width in the ends of the long bones, and exostoses of all types.

The trabeculations are coarser and more dense and the chondromas are more prominent in the phalanges than in the long bones. No stippling is seen. The phalanges show chondromas at their proximal ends and the metacarpal involvement is more advanced distally. The hands are much more characteristic of the changes ascribed to Ollier's type of chondroma than those typical of multiple exostoses. However, the wrist and knee, as well as long bones, are quite characteristic of hereditary, deforming chondrodysplasia.

Fig. 4. The hand film of the second child shows the minute dense areas in the carpal region. Chondromas are present in varying sizes in metacarpals and phalanges in our older patients.

With these pictures before us the general subject is considered.

Hereditary, deforming chondrodysplasia is a disturbance of bone growth beginning early in childhood, and characterized by multiple cartilaginous and osteo-cartilaginous growths within or on the skeletal system. The microscopic appearance is in no way different from a single exostosis. It is a retardation of normal transformation of primordial cartilage into bone, and not primarily a bone tumor.

The following, briefed from Geschickter and Copeland's, "Tumors of Bone," seems to be the best explanation of the method of development:

A single exostosis is formed as an exaggeration of a normal bony protuberance when maladjustment occurs between the periosteum of the tuberosity and the precartilaginous connective tissue of the tendon. Hereditary, deforming chondrodysplasia may be a similar disturbance. In its earliest state periosteum is really perichondrium. If there is an arrest of development and tendency for precartilaginous tissue to persist, the bones of cartilaginous origin will be affected. The failure of periosteum to develop adequately results in two conditions: first, the cortex does not achieve its full thickness, and second, the periosteal envelope is inadequate and does not form an efficient limiting membrane to bone growth. This failure results in widening of the metaphysis and irregular protrusions through points of defect in the periosteum.

The clinical findings are few—visible lumps in the arms and legs, tumors of the fingers and toes, and pain or impaired function due to pressure. There are usually no neurological signs. Local paralysis or paraplegia may result from large tumors and at least one aneurysm from vessel trauma has been reported. Malignant degeneration usually takes the form of chondromyxosarcoma. The prognosis for life is excellent, but no cure is offered. Large masses may be surgically removed, but occasionally recur.

The roentgen appearance is striking and is the basis for positive diagnosis. Usually all long bones are involved, but the fibula and ulna show most characteristic changes. These bones are short, bowed, and—es-

pecially in the wrist and knee—bend toward the heavier bone and may even fuse with it. The diaphyseal ends of the bones are vacuolated, broadened, and these contain stripes or striations which increase with age in both width and density. Exostoses grow from the cortical regions and follow the line of muscle pull. These growths may be of any type. Central enchondroma may be present and resemble a bone cyst. Phalanges, metatarsals, and metacarpals contain simple enchondroma, but carpal and tarsal bones are almost never affected.

Fig. 5. Films of the femora are not entirely satisfactory due to the effort to get both the proximal and distal ends on one film. However, they show the exostoses as they develop with increased age.

In differential diagnosis certain requirements are stated:

1. Hereditary factor.
2. Presence of ossifying ecchondromas or exostoses.
3. Broadening of metaphyses which begins abruptly and is called ' trumpeting."
4. Bone homogeneous, though enchondroma may be present.

Our cases are not proven to show hereditary transmission, but the possibility cannot be ignored. Both exostoses and central chondroma are present, though one will predominate in one child and the other in another. The broadening of metaphyses is present in older cases and less prominent in the younger ones. As it seems reasonable to assume that all of these children have different stages of the same disease, and as some show a preponderance of exostoses and others an excess of the chondromal changes, we are forced to believe they are basically the same pathology. The cricitism that the term "hereditary, deforming chondrodysplasia" confuses multiple exostoses and multiple chondromas becomes very pertinent, for the confusion appears to be not in the terms, but the nature of the lesion.

Summary.—Four, and possibly five, cases of hereditary, deforming chondrodysplasia are presented. All are in the same family and they show progressive stages of development of this disease.

BIBLIOGRAPHY

1. BRAILSFORD, J. F.: Dystrophies of Skeleton. British Jour. Radiology, September, 1935, **8**, 533–567.
2. Idem: The Radiology of Bones and Joints. William Wood and Company, 1935.
3. BROMER, R. S., and RUTHERFORD, L. J.: Ollier's Disease, Unilateral Chondrodysplasia. Am.

Jour. Roentgenol. and Rad. Ther., September, 1931, **26**, 428–435.

4. EHRENFRIED, A.: Hereditary Deforming Chondroplasia; Multiple Cartilaginous Exostoses: A Review of the American Literature and Report of 12 Cases. Jour. Am. Med. Assn., Feb. 17, 1917, **68**, 502.

5. GESCHICKTER, C. F., and COPELAND, M. M.: Tumors of Bone. Am. Jour. Cancer, 1931.

6. GOLDEN, ROSS (Ed.): Diagnostic Roentgenology. Thomas Nelson & Sons, 1936.

7. GOLDING, F. C.: Chondro-osteo Dystrophy. British Jour. Radiology, July, 1935, **8**, 457–465.

8. HALE, K.: Hereditary Deforming Chondrodysplasia or Multiple Exostoses. Ann. Surg., 1930, **92**, 92–114.

9. HUNTER, D., and WILES, P.: Dyschondroplasia (Ollier's Disease). British Jour. Surg., **22**, 507–519.

10. KING, E. S. J.: Rarefying Conditions of Bone. William Wood and Company, 1935.

11. PERCY, N. M.: Multiple Chondro-osteoma. Surg., Gynec. and Obst., 1915, **20**, 619.

12. SLOAN, D., SLOAN, M. F., and GOLD, A. M.: Dyschondroplastic Bow Legs. Jour. Bone and Joint Surg., January, 1936, **18**, 183–187.

13. WEINSTEIN, M. L., and COTELL, H.: Dyschondroplasia. RADIOLOGY, March, 1934, **22**, 359–364.

14. YENIKOMSHIAN, H. A., and BLAKE, H. K.: Familial Bony Dystrophy with Multiple Exostoses. RADIOLOGY, May, 1935, **24**, 623–625.

DISEASES AFFECTING THE INTERVERTEBRAL FORAMINA

By ALBERT OPPENHEIMER, M.D., *Beirût, Lebanon (Syria)*

From the Department of Roentgenology, American University of Beirût

I. CLINICAL RELATIONS

THE roentgen findings here presented concern a syndrome of recurrent or persistent pain, discomfort, and progressive disability clinically suggestive of rheumatism, arthritis, or referred symptoms from internal diseases. In observations recently reported by E. L. Turner and the present writer, segmental neuritis, resulting from compression of nerve roots within the intervertebral foramina, has been shown to be a common cause of these symptoms. In the case of backache and sciatica, the correlation with a special type of spinal lesion is well known, but it has not yet been generally recognized that similar diseases in other segments of the spine, as well as pathologic processes of a different origin, may and do produce narrowing of intervertebral foramina and symptoms of segmental neuritis in various regions of the body. As a differentiation of these conditions has been found useful in determining the appropriate treatment, an attempt is here made to classify the roentgen findings, especially those hitherto undescribed, that are typical of chronic diseases leading to compression of nerves within the intervertebral foramina.

II. ROENTGENOLOGIC ASPECT OF NORMAL FORAMINA

Anatomically, the intervertebral foramen is bounded at its anterior margin by the posterior surface of the vertebral bodies (covered by the posterior longitudinal ligaments), the gap between the bones (intervertebral space) being filled by the posterior part of the annulus fibrosus of the intervertebral disc. The upper and lower margins are formed by the concave borders of the pedicles of the superjacent and subjacent vertebræ, respectively. The posterior margin is marked by the synovial membrane and ligaments of the apophyseal joint. Roentgenologically, the structures involved are visible in lateral and oblique views of the spine. It is noteworthy in this connection that the direction of the intervertebral foramina (or, better, *passages*) is not the same in all parts of the column. Throughout the dorsolumbar region, the direction is almost exactly laterad; in the neck, it is oblique, midway between laterad and ventrad, forming an angle of about 45° with the median plane of the body, and again, the last (fifth) lumbar passage turns slightly ventrad. On the other hand, the apophyseal joints of the cervical vertebræ are lateral in position, and the narrow joint space between adjacent facets can be seen best in a strictly lateral view; while, in the dorsal region, the articular processes are placed farther back and the joint spaces are best seen in a slightly oblique view, from behind the transverse plane, the film making, with the median plane, an angle of less than 45°. Finally, in the lumbar region, the articular processes lie still farther back and, to make the joint spaces visible, the film must be inclined obliquely backward at an angle of very nearly 45°.

The size of the foramina is variable. After numerous trials made in the course of the last two years, the writer has abandoned the idea of exact measurement. The distance between the foramina and the film varies considerably with the transverse diameter of the vertebræ, the thickness of the intervening muscles, subcutaneous tissue, and skin, and the transverse diameter of the corresponding part of the body, thus producing variations in size according to the laws of projection. Wherefore, instead of relying upon figures that are, of necessity, falsely exact, one should compare by measurement the width of normal with that of abnormal foramina in the same

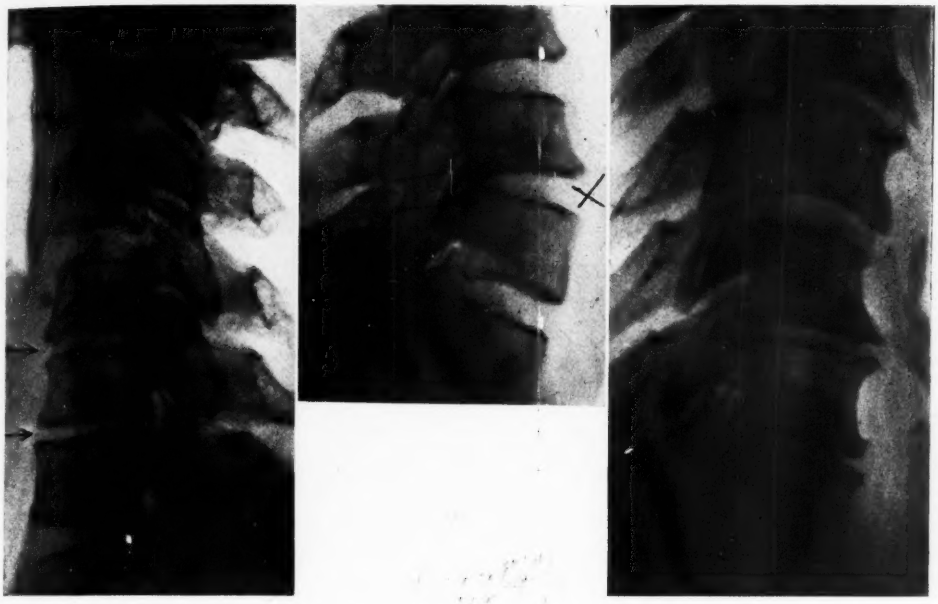


Fig. 1-*A* Fig. 1-*B* Fig. 1-*C*

Figs. 1-*A*, 1-*B*, and 1-*C*. Discogenetic disease, cervical spine. (1-*A*) Marked thinning of two discs, no bony reaction. (1-*B*) Thinning of the posterior part of one disc; exostoses (arrows) at the adjacent posterior margins. (1-*C*) Thinning of four discs, generalized exostotic deformities. Note absence of any pathologic changes in the apophyseal joints.

patient. This method has proved highly satisfactory.

The following report is based upon a study of more than a thousand roentgenologic examinations of the spine made in the course of three years.

III. TECHNIC

The examination in diseases affecting the foramina is based upon anterior, lateral, and oblique aspects. Oblique views are taken from both sides, right and left. To reproduce physiologic conditions, the views should be taken, preferably, in the erect position, the patient being instructed to refrain from any attempt to force himself into an unwonted posture, especially straightening of the spine. In some instances, however, forced lordosis is advisable, as it shows early changes not yet visible in the ordinary position: lordosis causes narrowing of the foramen (Brown). For the oblique view, the patient is posed with the back toward the film, the transverse vertical plane of the body making an angle of from 45° to 60° with the film. It is, of course, the foramen farther from the film that will be projected axially. A focal distance of not less than four feet is preferable. The penetration chosen should not be too high, otherwise early calcifications may escape visualization.

IV. PATHOLOGIC ANATOMY

It is evident that all destructive and all deforming processes may, under certain conditions, involve the intervertebral foramina. Primary and metastatic tumors, Pott's disease, osteitis fibrosa, spondylolisthesis, and prespondylolisthesis are known to initiate such changes. In this report, of the common chronic diseases of the spine that affect the foramina, only those are discussed which have not yet received systematic description.

Narrowing of the foramen is produced either by breakdown of tissues that normally hold in place the bones encircling the

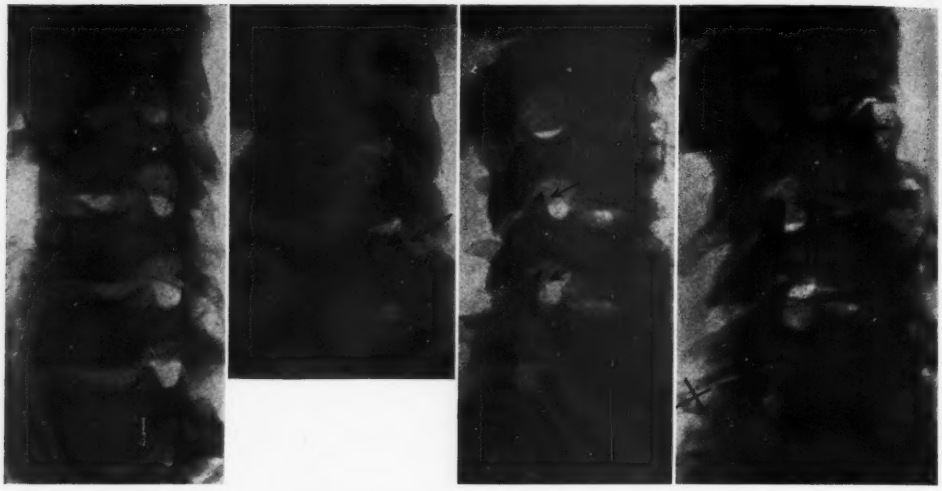


Fig. 2-*A* Fig. 2-*B* Fig. 2-*C* Fig. 2-*D*

Figs. 2-*A*, 2-*B*, 2-*C*, and 2-*D*. Collapse of foramina in discogenetic disease. (2-*A*) Normal. (2-*B*) Same case as shown in Figure 1-*B*; forward displacement of corresponding articular process (arrow). (2-*C*) Two articular processes displaced. (2-*D*) Pronounced displacement; foramina 8-shaped. Note exostoses of the bodies in 2-*D*, and tiny spurs at the tips of the processes involved in 2-*C* and 2-*D*, in the absence of changes of the joint space.

foramen, or by formation of tissues which encroach upon its lumen. It is convenient to distinguish these two different mechanisms by calling the former *collapse*, and the latter *constriction* of the foramen. Any part of the circumference may be affected.

of disc material and to acute thinning often associated with herniation of parts of the disc into the spinal canal (Mixter and Ayer, Glorieux), or with extrusion of the nucleus pulposus, or a part of it, into the bodies of adjacent vertebræ (Schmorl's

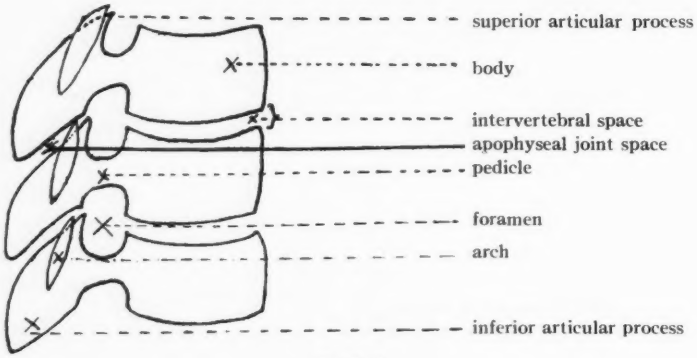


Fig. 2-*E*.

A. COLLAPSE OF THE FORAMEN

(1) *Thinning of Intervertebral Discs (Discogenetic Disease).*—Traumatic rupture of the annulus fibrosus, for example, after lumbar puncture (Milward and Grout), fractures or contusions of vertebræ, leads to leakage

nodules). The narrowing of the intervertebral space, thus produced, causes collapse of the anterior half of the intervertebral foramen followed by anterior subluxation of the superior articular process of the subjacent vertebra (Williams and Yglesias,

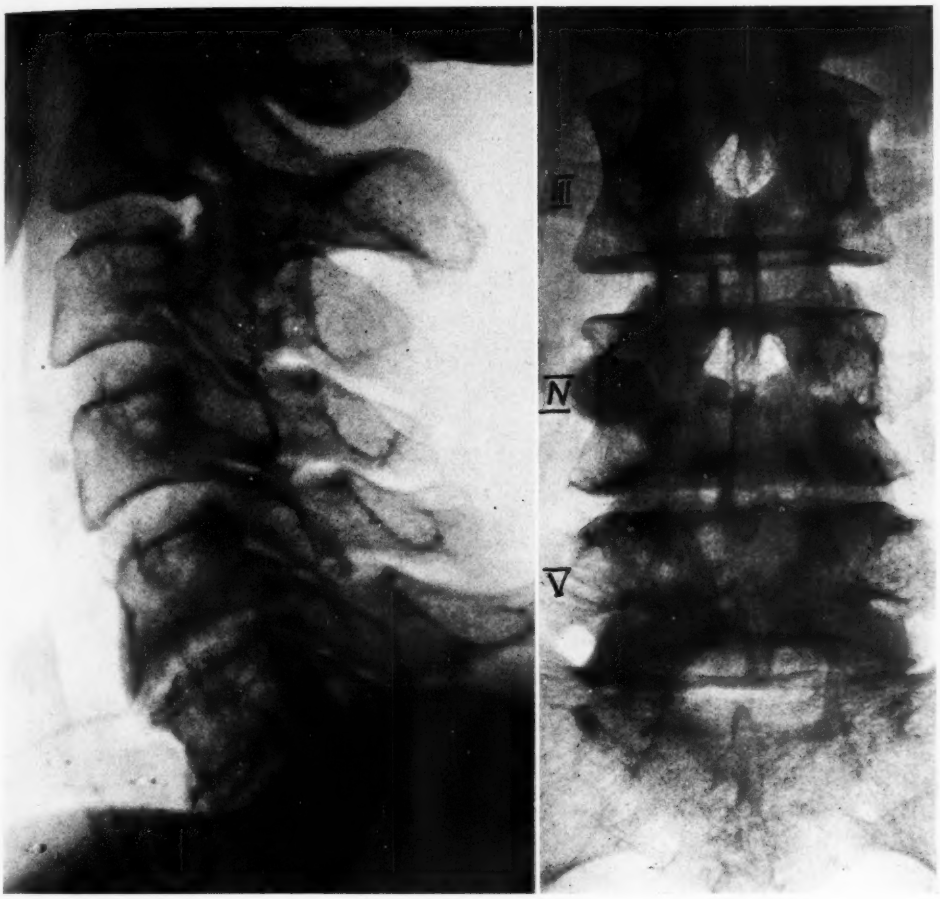


Fig. 3-*A* Fig. 3-*B*

Figs. 3-*A* and 3-*B*. Discogenetic disease. Typical localization in lower cervical and lower lumbar spine. In this patient, the other sections of the spine were found normal. Note exostoses in 3-*A*, corresponding to eburnation in 3-*B*.

Hadley, Oppenheimer and Turner, and others). Pressure upon nerve roots results and may be aggravated by herniation of the disc into the spinal canal (Mixter and Ayer, Alajounine and Petit-Dutaillis). The same mechanical changes (Fig. 2) are produced by gradual thinning of the disc, which occurs either as a late consequence of trauma, many years after the injury, or as a result of degenerative processes (Schmorl) associated with dehydration (Pueschel), possibly also due to faulty posture (Brown) or hypothetical disturbances in nutrition (Oppenheimer and Turner).

Thinning of discs occurs most frequently in the lower part of the neck (fifth to seventh cervical vertebra), and in the lower lumbar region, especially at the lumbo-sacral articulation. Now these are precisely the most flexible parts of the spinal column, and it is here, in these two regions, that (apart from the sacral nerves) the thickest nerve-roots issue from the spinal canal, namely, those concerned in forming the brachial and lumbar plexuses, respectively, from which the great muscular masses of the limbs receive their nerves. But the intervertebral passages

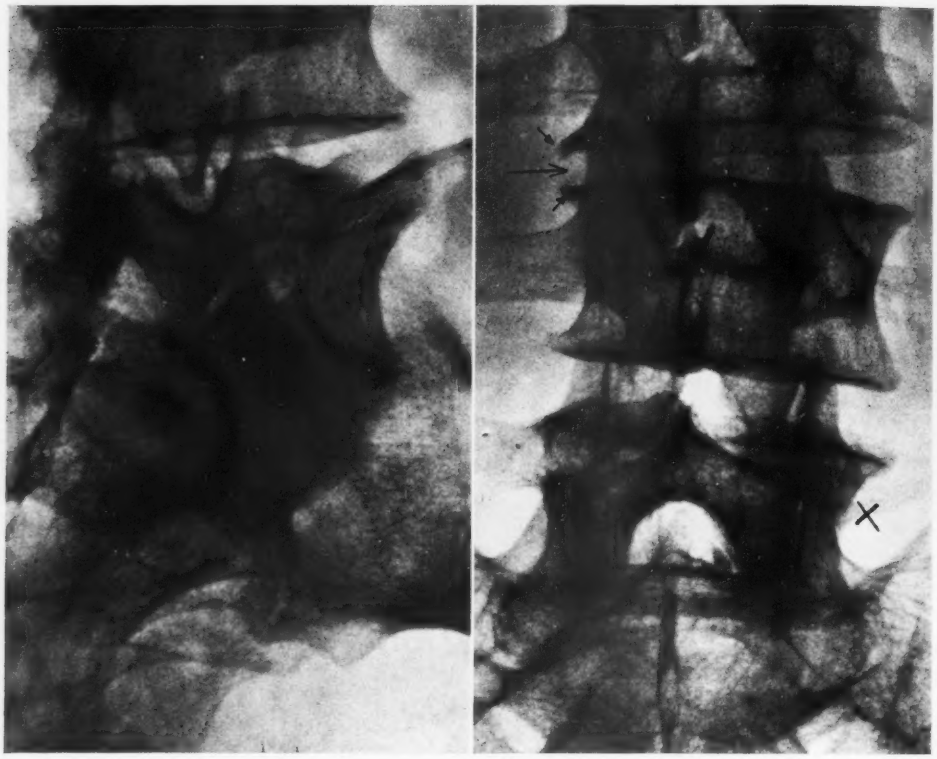


Fig. 4-*A* Fig. 4-*B*

Figs. 4-*A* and 4-*B*. Discogenetic disease. Sacro-lumbar disc destroyed; impingement of sacral process upon fifth lumbar vertebra (cross in 4-*B*). Compare position of upper (normal) with lower processes in 4-*A*. Unilateral (right) thinning of fourth lumbar disc; only the right articular processes are displaced (large arrow); exostoses only on the diseased side (small arrows). Apophyseal joints free in spite of displacement.

for the said roots are not wider (or, at least, not proportionately wider) than those in other parts of the spine where the nerve-roots are much more slender; consequently, the roots of the lower cervical and lower lumbar nerves are more liable to compression if their passages are reduced even slightly in caliber.

Not always is the whole of the disc found thinned; frequently it is only the posterior half (Williams and Yglesias), or one side, left or right (Oppenheimer and Turner), which appears reduced in height (Figs. 2-*B* and 4-*B*). The mechanical irritation of the adjacent vertebral surfaces, due to abnormal contact resulting from defect of the disc, leads to the development of exostotic deformations (Keyes and Compere) typical of hypertrophic spondylitis (Schmorl's deforming spondylosis). Similar alterations at the apophyseal joints may produce bony impingement upon articular processes (Hadley) or exostotic deformities at the tips of the processes involved (Oppenheimer).

Roentgenologically, the diagnosis is based upon the demonstration of a reduced intervertebral space and of subluxation of the articular processes. The reduction may be partial in the case of unilateral or posterior thinning of the disc, and less or more marked according to the degree of thinning. In the oblique view, the characteristic forward displacement of the lower articular process of the apophyseal joint is seen as a sort of step formed in the posterior border

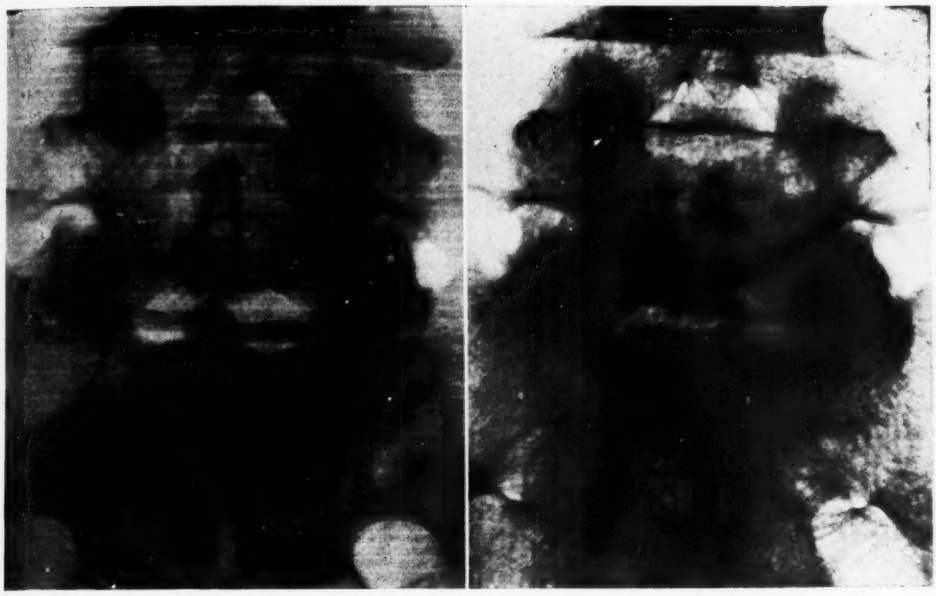


Fig. 5-*A* Fig. 5-*B*

Figs. 5-*A* and 5-*B*. Progressive eburnation of the vertebral bodies in discogenetic disease. Six months' interval between 5-*A* and 5-*B*.

of the foramen, in consequence of which the outline of the foramen comes to resemble the figure 8. The decrease in height is not always as clearly demonstrable. In quite a number of observations, the subluxation of the articular process was definitely more distinct than the narrowing of the intervertebral space. In serial examinations made at intervals of from six to eight months, progressive eburnation of the bony surfaces adjacent to narrowed intervertebral spaces is demonstrable (Fig. 5); exostotic deformations follow eventually; on the vertebral bodies they appear as lipping of the anterior and lateral margins; on the articular processes, as dense rounded nodules or spurs projecting into the lumen of the foramen (Fig. 2-*D*). Calcifications of ligaments do not occur in typical cases. If present, they are in general signs of an associated inflammatory process.

(2) *Rarefaction of the Articular Process.*—This is a comparatively rare condition recently described by the present writer. The etiology is unknown; in two cases out of seven, pulmonary tuberculosis was present. The affected inferior articular process is decreased in height, irregular in bony structure, and slightly deformed. The tip of the articular process opposite to the diseased bone protrudes into the latter, thereby producing a lenticular impression surrounded by bone of increased density (Fig. 6). There are no signs of thinning of discs nor of subluxation of apophyseal joints, showing that this condition is different from the bony impingement observed in discogenetic disease. The penetration of the superjacent into the softened process leads to collapse of the posterior part of the foramen: all the patients observed suffered from severe segmental neuritis. The commonest seat of this disease is the pedicle of the sixth cervical vertebra, which, even in normal spines, is often somewhat thinner than the adjacent ones. Moreover, it is probably subjected to greater compression than the others when the pedicles of the fifth, sixth, and seventh vertebræ are closely crowded together in backward movements of the neck.

Fig. 6. Rarefaction of sixth cervical articular process.

Fig. 7. Expansion of discs following softening of vertebral bodies. Parathyroidism.

(3) *Diseases of the Vertebral Bodies.*—In these conditions, narrowing of the intervertebral foramina occurs only when the discs are affected by the underlying process. In infections and tumors of the vertebral bodies, this is not constant (Freedman). If the disc is involved, the same changes as those found in discogenetic disease will produce collapse of the foramen. A normal disc, on the contrary, owing to its expansion (measured by Petter) will widen the interspace between vertebræ softened by a rarefying process (Baron and Barsony, Moffat, and others); consequently, no narrowing of the foramina is observed (Fig. 7). In this connection, one should remember that, owing to the particular condition of their nutrition, the discs are never found primarily infected, and that infectious material must pass through the lamina cribrosa of the vertebral surfaces before reaching the annulus fibrosus. It is easy to see, therefore, that infections in the vertebræ do not of necessity involve the discs; accordingly, in infectious spondylitis compression of nerve-roots is not constant.

B. CONSTRUCTION OF THE FORAMEN

(1) *Primary Arthritis of the Apophyseal Joints* (*Spondylarthritis*).—This is an inflammatory disease involving primarily the synovial membranes of the apophyseal joints (Eugen Fraenkel), probably of bacterial origin (Nathan), and sometimes the result of focal infection (Golding, Oppenheimer). It may be systemic or localized; it may also be associated with rheumatoid arthritis in other joints, *e.g.*,

costo-transversal articulations, hips, or shoulders (type Pierre-Marie-Struempell).

Fig. 8-*A*

Fig. 8-*B*

Fig. 8-*C*

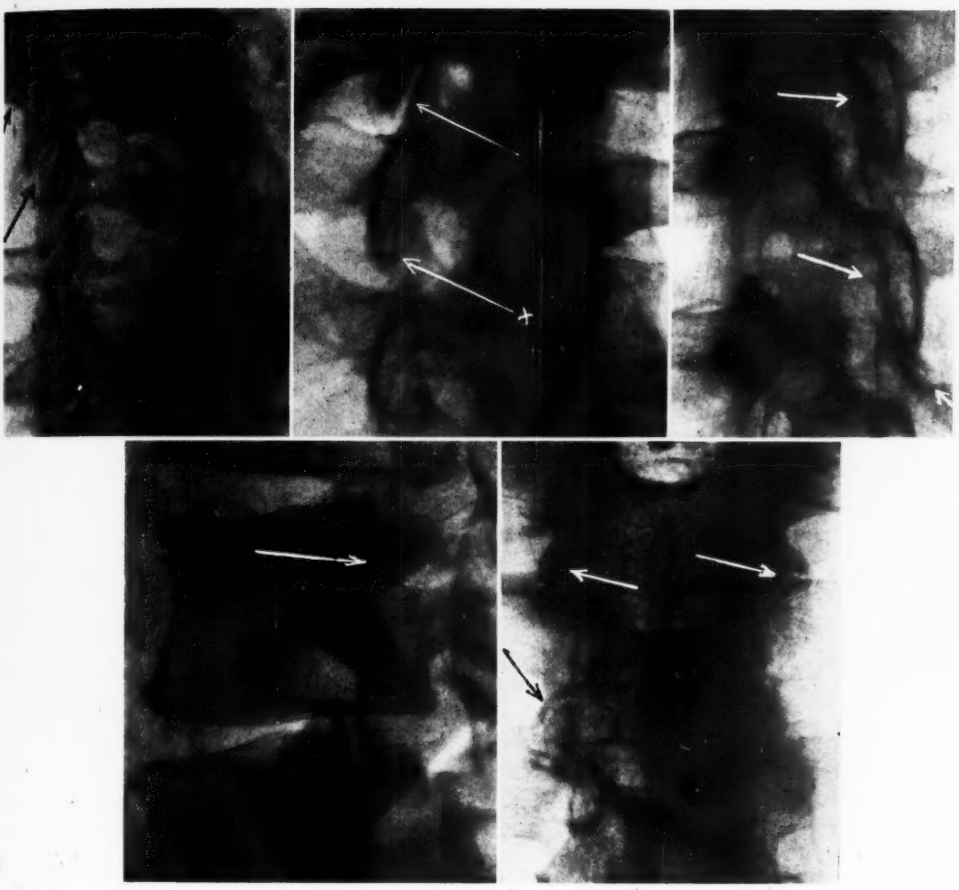


Fig. 8-*D*

Fig. 8-*E*

Figs. 8-*A*, 8-*B*, 8-*C*, 8-*D*, and 8-*E*. Spondylarthritis. (8-*A*) Cervical spine; arthritic deformities with beginning ankylosis, calcification of ligamentum flavum. (8-*B*) Upper arrow indicates normal; lower arrow, ankylosed dorsal apophyseal joint. (8-*C*) Ankylosis of dorsal apophyseal joints, with arthritic excrescences encroaching upon the foramina. (8-*D*) Beginning ankylosis of one lumbar apophyseal joint; roughening of articular surfaces. (8-*E*) Ankylosis and exostostic formations of costo-transversal joints.

If not arrested in its early stages, it results in ankylosis of the articular facets (spondylarthritis ankylopoetica), followed by ossification of the longitudinal ligaments of the spine (type Bechterew). Constriction of intervertebral foramina, in this disease, results from inflammatory swelling of the peri-articular tissues, or, later, from ossification of synovial membranes and ligaments, and arthritic deformities of the apophyseal joints. Very recently, F. Campbell Golding has discussed various theories concerning the etiology and pathogenesis of this disease.

Roentgenologically, in early stages, the constriction, due to swelling of soft tissues, is not demonstrable. In cases of segmental neuritis pointing toward a spinal lesion, however, mottled demineralization of the articular processes (Koch), or roughening of the articular surfaces of the apophyseal joints, are strongly suggestive of spondyl-

Fig. 9-*A* Fig. 9-*B*

Figs. 9-*A* and 9-*B*. Spondylarthritis. (9-*A*) Calcification of anterior (9-*B*) of posterior longitudinal ligaments. Note ankylosis of lower apophyseal joints in 9-*B*. Discs normal!

arthritis. Generally speaking, the oblique view will show thornlike prominences at the tips of the articular processes (Fig. 8-*C*). In more advanced stages, ossifications of apophyseal ligaments are made visible by the lateral view. Sometimes, concentric layers of calcified tissues narrow the lumen of the foramen (Figs. 10-*B* and 10-*E*). Finally, ankylosis of the facets is demonstrable in the lateral aspect, and is almost invariably associated with calcifications of the longitudinal ligaments connecting the vertebral bodies. The anterior outline of the foramen is marked, in these cases, by a dense linear calcification bridging over the posterior part of the intervertebral space (Fig. 10). It is essential to note that the intervertebral space remains normal in width, as the discs are not affected by the disease. This makes it possible to distinguish between primary arthritis and the secondary changes mentioned as occurring in discogenetic disease.

(2) *Spondylosis ossificans*.—Calcification of apophyseal ligaments may also occur in non-inflammatory diseases, degenerative processes being known to initiate ossifications (Schmorl). Bakke has recently described a condition which he has named *spondylosis ossificans ligamentosa localisata*, and which is marked by ossification of the ligamenta flava. He considers that abnormal tension of these ligaments initiates the changes. The distinction between this disease and a localized type of spondylarthritis ankylopoetica seems, as yet, difficult to establish. Roentgenologically, linear calcifications between the tip of the articular process and the pedicle may, in the absence of other spondylarthritic changes, suggest Bakke's spondylosis ossificans.

V. CONCLUSIONS

Two groups of diseases, differing distinctly in origin and mechanism, may lead to narrowing of intervertebral foramina. Following the breakdown of tissues which normally support the bones encircling the foramen, mechanical *collapse* occurs and results in decrease in height, with consequent luxation of the articular process, causing decrease in the lateral diameter. On the other hand, inflammatory swelling

of peri-articular tissues, followed by ossifications of membranes and ligaments, will is found narrowed in the former condition, it is of normal width in the lat-

Fig. 10-*A* Fig. 10-*B* Fig. 10-*C*

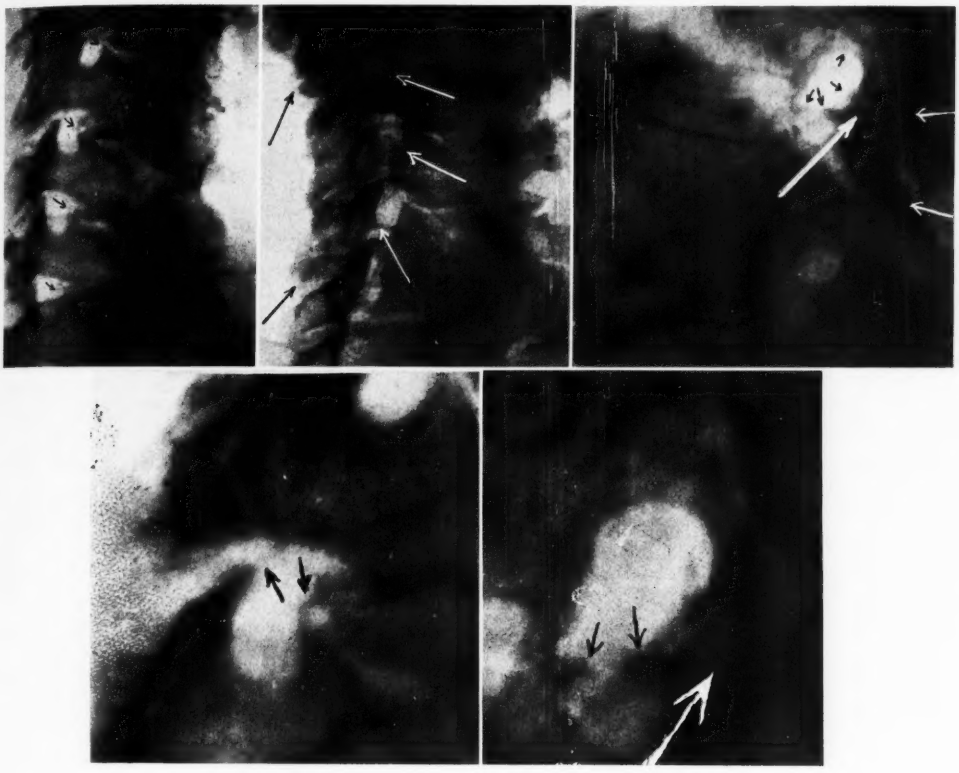


Fig. 10-*D* Fig. 10-*E*

Figs. 10-*A*, 10-*B*, 10-*C*, 10-*D*, 10-*E*. Types of spondylarthritic constriction. (10-*A*) Calcified posterior longitudinal ligament bulges into foramina (enlargement in 10-*D*). (10-*B*) Arthritic deformities (black arrows), and calcified ligaments (white arrows). (10-*C*) Arthritic deformities (black arrows) encroach upon the foramen; beginning ankylosis of apophyseal joint (white arrows). Enlargement in 10-*E*.

constrict the foramen by encroachment upon its lumen. In either case, deformities of the articular processes and abnormal ossifications of the vertebral bodies may complicate the roentgenologic aspect. *Collapse* consequent upon discogenetic lesions is often associated with those exostotic "spiculations" typical of hypertrophic spondylitis (Schmorl's deforming spondylosis). *Constriction* due to primary arthritis of the apophyseal joints is associated with calcifications of the longitudinal ligaments typical of ankylopoietic spondylarthritis; but whereas the intervertebral space ter. Hypertrophic spondylitis (deforming spondylosis), however, is not caused by lesions of the disc only, as it is no more than a reaction consecutive to alterations of different origin. Ankylopoetic spondylarthritis, on the other hand, is invariably correlated with ossifying changes in the apophyseal joints. *Collapse* results mainly from thinning of the discs, hence it begins at the anterior margin of the foramen; *constriction* results from inflammation of the synovial membranes of the apophyseal joints, hence its commencement is at the posterior margin.

The clinical consequences and therapeutic measures determined by these mechanisms have been discussed in a separate report.

VI. SUMMARY

1. In the classification of diseases that involve the intervertebral foramina, *collapse* of the foramen is distinguishable from *constriction*. The roentgenologic appearances are described.

2. *Collapse* is produced by softening, rarefaction, or loss of elasticity in tissues which normally support the bones that encircle the foramen. Thinning of intervertebral discs (discogenetic disease) and rarefaction of articular processes invariably cause collapse.

3. *Constriction* is produced by inflammatory swelling of the synovial membranes of the apophyseal joint, followed by calcification of ligaments and ankylosis of the facets. The discs are not involved.

4. The correlation of these conditions with hypertrophic spondylitis (deforming spondylosis) and ankylopoietic spondylarthritis is discussed.

BIBLIOGRAPHY

ALAJOUNINE, T., and PETIT-DUTAILLIS, D.: Le Nodule fibro-cartilagineux de la face postérieure des disques intervertébraux. Presse méd., 1930, **38,** 1749–1751.

BAKKE, S. N.: Spondylosis Ossificans Ligamentosa Localisata. Fortschr. a. d. Geb. d. Röntgenstrahlen, March, 1936, **53,** 411–417.

BARON, A., and BARSONY, T.: Zentral eingedellte Wirbelkoerper. Fortschr. a. d. Geb. d. Röntgenstrahlen, 1927, **36,** 377.

BROWN, L. T.: The Conservative Treatment of Backache. Jour. Bone and Joint Surg., January, 1932, **14,** 157–164.

FRAENKEL, EUGEN: Berliner klin. Wchnschr., 1917; quoted by Kaufmann, E., Pathology (Philadelphia, 1929).

FREEDMAN, E.: Behavior of the Intervertebral Disc in Certain Spine Lesions. RADIOLOGY, February, 1934, **22,** 219–235.

GLORIEUX, P.: La physiologie pathologique et les diverses formes de fractures de la colonne. Fortschr. a. d. Geb. d. Röntgenstrahlen, March, 1936, **53,** 422–434.

GOLDING, F. CAMPBELL: Spondylitis Ankylopoietica. British Jour. Surg., January, 1936, **23,** 484–500.

HADLEY, L. A.: Subluxation of the Apophyseal Articulations with Bony Impingement as a Cause of Back Pain. Am. Jour. Roentgenol. and Rad. Ther., February, 1935, **33,** 200–213 (209).

KEYES, D. C., and COMPERE, E. L.: The Normal and Pathological Physiology of the Nucleus Pulposus of the Intervertebral Disc. Jour. Bone and Joint Surg., October, 1932, **14,** 897–938.

KOCH, C. E.: Zur Fruehdiagnose der Spondylarthritis ankylopoietica. Fortschr. a. d. Geb. d. Röntgenstrahlen, March, 1936, **53,** 418–422.

MILWARD, F. J., and GROUT, J. L. A.: Changes in the Intervertebral Discs Following Lumbar Puncture. Lancet, July 25, 1936, **2,** 183–185.

MIXTER, W. J., and AYER, J. B.: Herniation or Rupture of Intervertebral Disc into the Spinal Canal. New England Jour. Med., Aug. 29, 1935, **213,** 385–393.

MOFFAT, B. W.: Enlargement of the Intervertebral Disc Associated with Decalcification of the Vertebral Body: A Compensatory Hypertrophy. Jour. Bone and Joint Surg., July, 1933, **15,** 679–695.

NATHAN, P. W.: The Neurological Condition Associated with Polyarthritis and Spondylitis. Am. Jour. Med. Sci., 1916, **152,** 162.

OPPENHEIMER, A.: Narrowing of Intervertebral Foramina as a Cause of Common Pseudo-rheumatic Pains. Manuscript submitted to Jour. Am. Med. Assn.

OPPENHEIMER, A., and TURNER, E. L.: Discogenetic Disease of the Cervical Spine. Manuscript submitted to Am. Jour. Roentgenol. and Rad. Ther.

PETTER, C. K.: Methods of Measuring the Pressure of the Intervertebral Disc. Jour. Bone and Joint Surg., April, 1933, **15,** 365–368.

PÜSCHEL, J.: Der Wassergehalt Normaler and Degenerierter Zwischenwirbelscheiben. Beitr. z. path. Anat. u. z. allg. Path., Feb. 14, 1930, **84,** 123–130.

SCHMORL, G.: Zur pathologischen Anatomie der Wirbelsäule. Klin. Wchnschr., July 2, 1929, **8,** 1243–1249.

Idem: Ueber Knorpelknoten an der Wirbelbandscheiben. Fortschr. a. d. Geb. d. Röntgenstrahlen, October, 1929, **40,** 629–634.

TURNER, E. L., and OPPENHEIMER, A.: A Common Lesion of the Cervical Spine Responsible for Segmental Neuritis. Ann. Int. Med., 1936, **10** (O.S. **15**), 427.

WILLIAMS, P. C.: Reduced Lumbosacral Joint Space. Jour. Am. Med. Assn., Nov. 12, 1932, **99,** 1677–1682.

WILLIAMS, P. C., and YGLESIAS, L.: Lumbosacral Facetectomy for Post-fusion Persisting Sciatica. Jour. Bone and Joint Surg., July, 1933, **15,** 579–590.

APPARATUS FOR THE SO-CALLED MUCOSAL RELIEF TYPE OF GASTRO-INTESTINAL EXAMINATION

By JOSEPH C. BELL, M.D., *Louisville, Ky.*

MY interest in the above type of examination dates from the appearance of Akerlund's excellent article on this subject in the January, 1931, issue of the "American Journal of Surgery." Since that time seven different film-carrying devices with provision for localized pressure over the part being examined have been designed, constructed, and given a thorough trial in my work. The first four were crude and proved entirely unsatisfactory. The fifth was more satisfactory (described in RADIOLOGY, February, 1935, **24,** 143–152). At this same time, apparatus was described by which one could change from the fluoroscopic setting to the radiographic, and then make the exposure by means of a hand-controlled magnetic switch. This so-called quick change-over switch has been in constant use for the past two years and is satisfactory in all respects.

Excellent films were secured, but the apparatus was difficult to operate, and no provision was made for maintaining pressure except by hand power. This tunnel was followed by the sixth which was much more nearly that for which we were seeking. A suitable device for maintaining pressure was incorporated, using the lock of the pressure band of a Bucky diaphragm. This lock is most satisfactory for it maintains any desired pressure with almost no rebound, and can readily be released.

The first three devices provided for a single exposure on a 5 × 7-in. film. In the fourth and fifth, four circular exposures, each $3^1/_2$ in. in diameter, were made

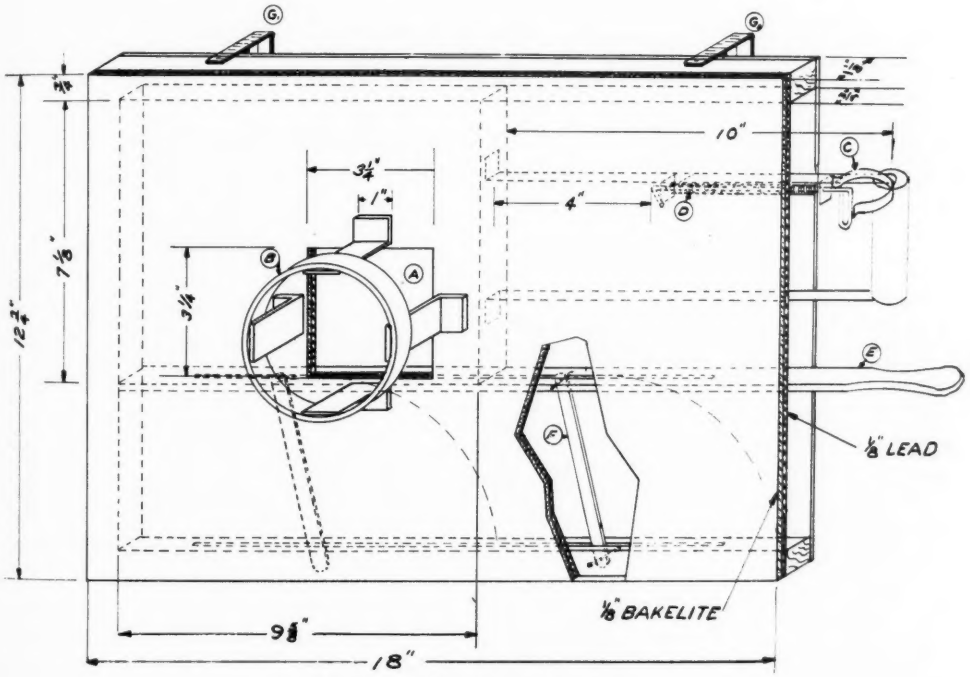


Fig. 1. Drawing of tunnel now in use.

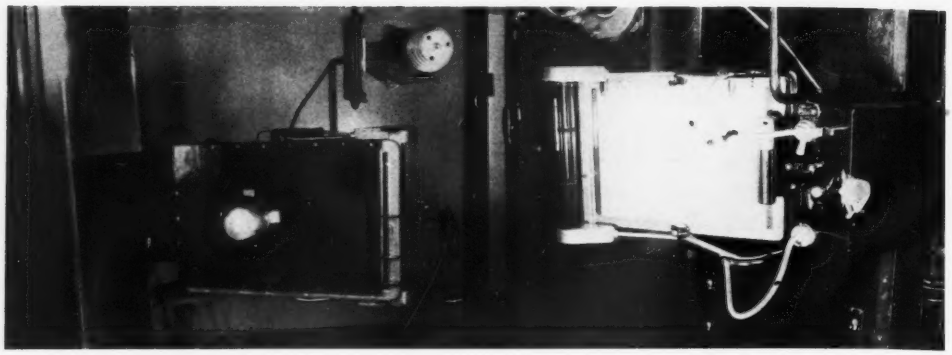


Fig. 2. Fig. 3.

Fig. 2. Photograph of tunnel attached to the fluoroscopic screen. Exposure switch is shown in position used. Tube above screen not used in this work.
Fig. 3. Photograph from operator's side of fluoroscope. Exposure switch shown on left. Lock for maintaining pressure shown on extreme right. Lock has fixed release when not in use.

on an 8 × 10 in. film. The film was turned by hand after the first two exposures in order that the third and fourth could be made. It then occurred to me that four exposures, each $3^1/_4$ in. in diameter, could be made on a $6^1/_2 \times 8^1/_2$ in. film, and with a suitable shifting device, that these could be made without rotating the film and without any increase in the weight and size of the apparatus over that used with the 8 × 10-in. film tunnel. In this tunnel the position of the film was governed by a track in which a film carriage bearing ran. It worked well but was difficult to construct, and the track interfered with fluoroscopy by cutting down the size of the opening through which one observed the part being examined. To remedy the above defects the seventh tunnel was constructed. It has now been in use for several weeks and satisfies all the requirements for this type of work, as I see them. The construction is relatively simple and relatively inexpensive. The size is just that of the ordinary fluoroscopic screen holder and the weight only 12 pounds and 8 ounces.

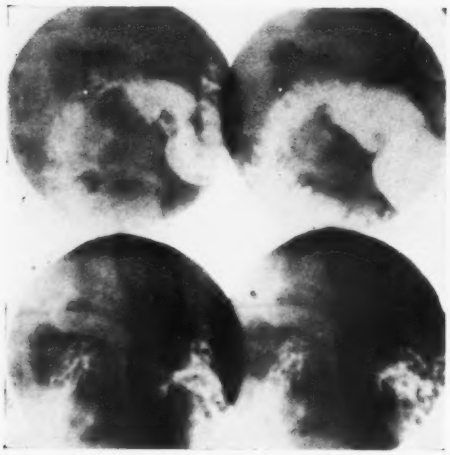


Fig. 4. Normal cap under varying degrees of pressure.

The following principles have constantly been kept in mind in dealing with this problem.

First, that the apparatus should be readily adaptable to that already in use in any well-equipped office or hospital at reasonable expense. This is true both of the so-called quick change-over switch and of the tunnel with its locking device.

Second, that it be simple both in construction and operation. This requirement is also satisfied. When the quick change-over switch operating mechanism is made a part of the film-shifting device the construction becomes complicated. Aside from this objection, it is not desirable to have this arrangement because the

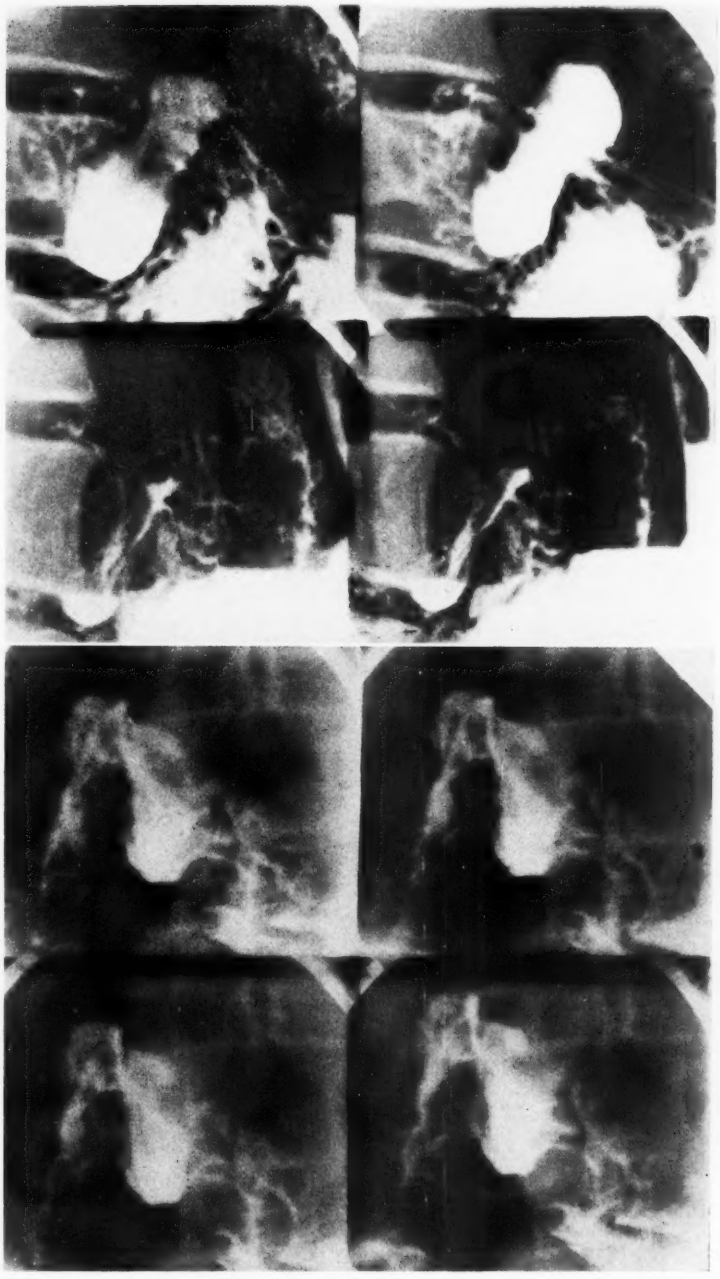


Fig. 5. Serial exposures of duodenal cap under varying degrees of pressure showing field of exposure.

Fig. 6. Serial exposures of another duodenal cap. Ulcer crater near apex. Patient had been under treatment. Ulcer crater was more sharply defined before treatment was instituted.

switch will be used constantly for purposes other than for making the so-called spot film. I use it at all times when I wish to record anything just as it is seen with the fluoroscope. This includes some lesions of the chest, some of the heart or great vessels, and many lesions of the esophagus, the gall bladder, the colon, and of the spinal cord. In addition to these, all serial or single exposure films of the stomach and duodenum are made with this switch.

Fig. 7. Serial films of distal third of stomach and duodenal cap made with patient prone using the ordinary serial tunnel. Slight deformity of cap is present. Distortion of mucosal folds faintly shown.

It is well to bear in mind the fact that we are not trying to demonstrate changes that are present one instant and gone the next. In my experience, if organic changes are present they are relatively easy to demonstrate by this method in most cases and do not require an instantaneous exposure. When a defect is so transient as to demand such an exposure, it probably has no organic basis, and a diagnosis based on such evidence may frequently be erroneous.

The third principle is that the apparatus should not interfere with the usual fluoroscopic examination. The fluoroscope will

and should be used in the usual manner many times more often than it will be for this work. For this reason it is logical to encourage inadequate fluoroscopy. It must be remembered that this method of examination will not be applicable or necessary

Fig. 8. Films of same case as shown in Figure 7, made with patient upright, using above-described compression apparatus. Degree of compression and angles were varied between exposures. Upper four views show distortion of mucosal folds of cap with only a suggestion of a niche. Niche is well shown in three of the lower exposures.

attach the apparatus to the fluoroscopic screen when it is needed rather than to have a fixed or semi-fixed apparatus which may in quite a large percentage of cases. It will not take the place of careful fluoroscopy, nor will the so-called spot film re-

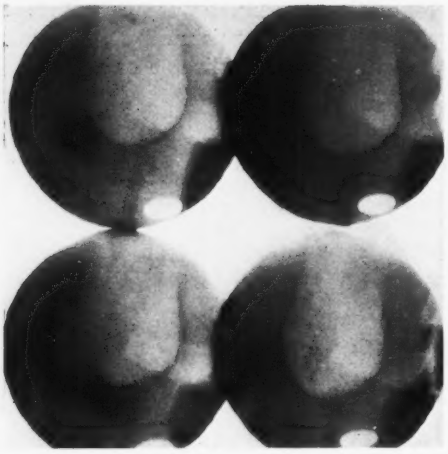


Fig. 9. Serial exposures of normal gall bladder.

place films of the usual type. I am greatly interested in this examination and use it in an increasingly large percentage of cases as my experience with it grows; nevertheless, my fluoroscopic examination is no less careful, but more so if anything, and each year I become more firmly convinced of the value of serial films (as described in the previously mentioned issue of RADIOLOGY). These three methods go hand in hand and will continue to do so in my work.

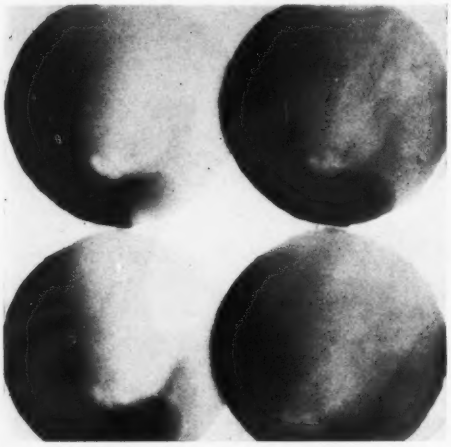


Fig. 11. Same case as shown in Figure 10, showing stones in fundus, with patient upright. Serial tunnel in use.

Fig. 10. The ordinary type of gall-bladder film showing somewhat atypical stones.

DESCRIPTION OF FILM TUNNEL

Figure 1 is a drawing showing the construction of the tunnel now in use. It is designed for use with a $6^1/_2 \times 8^1/_2$ in. film, the long diameter being horizontal.

A, the exposure portal, is $3^1/_4$ inches square. In the earlier models we used a round portal $3^1/_4$ inches in diameter, but since the shutters on most fluoroscopes form a square or rectangle and not a circle, it seemed logical to use a square portal because the fluoroscopic portal determines the amount of secondary radiation and not the opening in the tunnel. In addition to this, we desired as large a portal as was

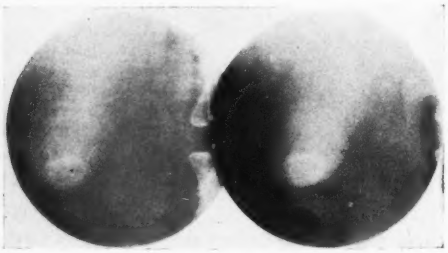


Fig. 12. Serial exposures of rather faint gall-bladder shadow, with large stone in fundus.

Fig. 13. Film of colon after opaque enema, showing filling defect in proximal part of sigmoid. The defect is evidently due to a pedunculated tumor, probably a polyp, which may well be undergoing malignant change.

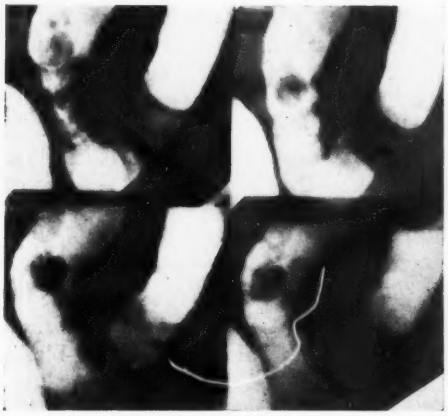


Fig. 14. Serial exposures of sigmoid of same case shown in Figure 13. The patient was supine and the films made with localized pressure over the lesion in the sigmoid. They illustrate the use of the above apparatus in the horizontal position.

consistent with good detail. Compression, however, is best made with a hemisphere because of the relationship of the parts being examined to the bony structures, and for this reason the ring *B* supports a removable hemisphere of aluminum. The hand switch for control of the quick change-over switch slips into the clamp *C* when the tunnel is in use, and exposures are made by pressure with the thumb. The hand grips the handle below the clamp *C* and shifts the film between exposures.

The device *D* was a rather complicated one for the purpose of stopping the film carriage when it had been moved into the proper position for the first and third exposures. It has been replaced by a small fixed metal shoulder welded to the side of the arm connecting the handle with the pan that holds the cassette. The arm is not as wide as the opening in the tunnel, and as the pan is pushed inward the arm is pulled slightly toward the operator until the shoulder strikes the edge of the tunnel. The exposure is then made. The arm is pushed away from the operator, and the film can then be moved inward into position for the next exposure.

E is a metal support which, when in the position shown, holds the film in position for the lower two exposures. The metal rods *F* hold it in this position and we have added a small spring lock at the margin of the tunnel to prevent the support from falling accidentally. After the first two exposures are made the lock is released, the support is pulled outward and drops to the bottom of the tunnel, where the film rests ready for the third and fourth exposures.

"*G* 1" and "*G* 2" are rubber-covered metal hooks with which the tunnel is suspended from the fluoroscopic screen holder. If one wishes to use the tunnel in the horizontal position, this may be done by clamping the lower margin to the margin of the screen holder.

OPERATION

The patient swallows a small amount of barium suspended in water. This is spread over the walls of the stomach or duodenum and careful fluoroscopic observations are made. If evidence of an organic lesion is

found, or a suspicious shadow observed, the tube is centered over this area and is locked in this position. The tunnel is then attached, the proper degree of pressure is obtained, and the exposures are made. No counter balance for the tunnel is employed with the one that is now in use because it is so light that this is not necessary.

ILLUSTRATIONS

The illustrations are chosen for the purpose of showing the area of exposure rather than striking pathology. The gall-bladder films are included because the value of films made in this way has recently been emphasized by Ettinger in the "American Journal of Roentgenology and Radium Therapy" (May, 1936, **35,** 656–661). Accurate centering is necessary if satisfactory films are to be made, but this is usually possible.

COMMENT

Some of the ideas used in the construction of this apparatus are original with the writer, but many are adaptations of methods used by others who employ this type of examination. If this work has any merit much of the credit is due Mr. J. W. Fowler, of the technical staff of the Norton Memorial Infirmary, who constructed the recent tunnels. The general ideas have been mine, but many of these ideas have been modified, improved and made practical from a construction standpoint, by him.

402 Heyburn Bldg.

FRACTURE-DISLOCATIONS IN THE REGION OF THE ATLAS AND AXIS, WITH CONSIDERATION OF DELAYED NEUROLOGICAL MANIFESTATIONS AND SOME ROENTGENOGRAPHIC FEATURES[1]

By GABRIEL A. SCHWARZ, M.D., *and* ROBERT S. WIGTON, M.D., *Philadelphia*

From the Departments of Neurology and Radiology, Hospital of the University of Pennsylvania

DISLOCATIONS and fractures of the first two cervical vertebræ have been accorded considerable attention in the literature. Almost all possible types of disturbance of the structures of this region have been reported. The typical cases of "broken neck," with characteristic local signs and symptoms, and a neurological picture of cord compression, are easily recognized although, unfortunately, these often fall into the fatal group. In the less severely traumatized cases, in which the local signs and symptoms and the nervous manifestations occur with or shortly after the accident, the condition is suspected clinically, and usually the diagnosis is confirmed by the roentgen examination.

There is, we believe, a type of fracture-dislocation in the upper cervical vertebræ which has not been emphasized in the literature. These cases present obscure, slowly progressive neurological signs and symptoms years after the trauma. At the time of the injury local signs and symptoms are absent, insignificant, or they rapidly disappear and leave no residual local disturbances. These cases become neurological diagnostic problems.

The importance of delayed signs and symptoms in fractures and dislocations of the atlanto-axial region has been mentioned by various writers. Osgood and Lund (1), in a discussion of 55 collected cases of fracture of the odontoid process, mentioned five cases in which the neurological picture did not develop until some time after the initial injury. Ogilvy (2) also called attention to the delay in the development of the signs, although his case had a latent period of only four days. Jackson (3), while reporting no illustrative cases, stated that "neurological symptoms may not appear until after the lapse of years, due to the slow development of myelitis." Bernstein (4) reported a case of anterior luxation of the atlas on the axis in which the neurological signs did not appear until 71 days after the accident. He referred to two other reports of delayed neurological signs: one of von Pries in 1792 with an interval of 60 days, and another of Costes in 1852 with an interval of four months. Ely (5) reported a case of dislocation of the atlas on the axis with fracture of the odontoid process in which signs of cord compression developed nine weeks after the injury. After failure of conservative therapy, he resorted to tying together the posterior arches of the atlas and the axis following which the patient made a complete recovery. Elliott and Sachs (6) described a patient with fracture of the odontoid process and atlanto-axial dislocation who developed recurrent paralysis following subsequent trauma with redislocation.

Other cases have been described in which neurological signs develop after a latent interval of from two to eight months.

In the above cases local signs were present and a history of injury was obtained. The interval before the onset of the neurological signs varied from four days to eight months. The neurological signs and symptoms were more or less rapidly progressive in all cases.

REPORT OF CASES

Case 1. W. R., a white male, aged 34,

[1] The authors wish to express their thanks to Dr. Eugene Pendergrass of the Department of Radiology, the late Dr. C. H. Frazier of the Department of Neurosurgery, and Dr. William G. Spiller of the Department of Neurology, for their helpful assistance and for the use of their records.

complaining of "dragging of the right leg," was admitted to the service of Dr. William G. Spiller at the University Hospital on Nov. 9, 1934.

The limping was first noted by a neighbor in 1928. Since 1930 there had been a slowly progressive increase in the limp, so that at the time of his admission he felt that he had to drag his right leg as though it were made of wood. He had no pain or sensory disturbance. The systemic review was negative. The past medical history, family history, and social history were essentially negative.

Physical Examination.—The general physical examination was entirely negative. The movements of the neck were free and equal.

Neurological Examination.—(Dr. M. J. Cooper, Nov. 13, 1934.) "The right lower limb is spastic, and the toe of the right foot drags as he walks, more because of spasticity than because of any foot drop. The flexion of the right knee with each stride is quite limited. There is some spasticity of the left lower limb also, but it is less than on the right side. Both arms swing moderately well in walking, but the swing of the right arm is more limited than that of the left. The patient is naturally right-handed. The motor power of the right upper limb is slightly reduced at the shoulder girdle, a little more reduced in movements at the elbow joint, and moderately impaired in the hand grasp and in the use of the intrinsic hand muscles. The left upper limb has approximately normal power except for a little weakness of the hand grasp. Movements at the hip and knee of the right lower limb are moderately weak, while in the left lower limb these movements are only slightly less powerful than normal.

"The peroneal muscles of the right side are a little weak; those of the left side are only slightly weak. The tibials are moderately weak on the right and about normal on the left. The calf muscles are considerably weakened on the right and only slightly weakened on the left. The coordination of all four limbs is about normal except for the slight impairment due to spasticity. The tendon reflexes of the upper extremities are considerably exaggerated on both sides. The Trömner reflex is markedly positive on the right and moderately positive on the left. The epigastric, lower abdominal, and cremasteric reflexes are absent on both sides. The patellar and Achilles reflexes are greatly exaggerated on both sides. Patellar and ankle clonus were present on both sides. There is an intense defense withdrawal of the right and left lower limb on plantar stroking, more intense on the right side."

Examination of the cranial nerves was negative. The sensations of touch, passive motion, position, and vibration were normal. Sensations of pain and temperature were slightly less acutely perceived on the left side of the trunk, although no definite line of demarcation was obtained.

Laboratory Findings.—Urinalysis and blood count revealed normal findings. The Wassermann and Kahn blood tests were negative. The first examination of the cerebro-spinal fluid revealed a medium positive Kahn test, a colloidal gold curve of 000111000, 4 leukocytes per c. mm., and 41 mgm. per cent of protein. On two subsequent examinations the cerebro-spinal fluid was found to have a negative serology, a colloidal gold curve of 0000000-000, protein content of 21.9 mgm. per cent, and 5 cells. The Queckenstedt test caused a rather limited rise of the cerebro-spinal fluid pressure after bilateral jugular compression (80 to 100 mm. of water rise above initial pressure). The rise and fall were prompt. A partial block was suggested but the evidence was considered to be inconclusive.

The roentgen examination of the lumbar spine was negative. The first roentgen report concerning the cervical region stated that there was an anterior dislocation of the atlas with the comment that a fracture of the odontoid process incident to the dislocation cannot be excluded. A later report following more careful studies of the region revealed a fracture-dislocation of the atlas on the axis. The odontoid proc-

ess was fractured and carried forward with the head. The atlas maintained its normal relation to the base of the skull (Fig. 1).

At first no history of an accident was secured. After the roentgen examination, upon direct inquiry, the patient did remember having fallen about fifteen feet from a hayloft at the age of ten years. He believed that he had struck his head and neck. He was unconscious for a short time and was semi-stuporous the rest of the day. The following morning it was noted that his head was tilted to the right and he was unable to straighten it because of pain in the back of the neck. A physician was consulted and suggested no special treatment. The patient remained unimproved. Several days later he was taken to an old woman of the neighborhood who placed him in a chair and with sudden force lifted his head erect. There occurred a sharp pain and a grating noise was heard. Recovery was complete and to this day there has been no difficulty in the movements of his head and neck.

Course.—The patient decided against the suggested operation for reduction of the dislocation and returned to his home unimproved. On April 3, 1936, the patient returned to the hospital for re-examination. He had remained much the same except that during the past year he had experienced some increasing pain in his right hip. A physical and neurological examination revealed that there had been no progression in his signs since discharge in December, 1934. No sensory disturbances were noted on careful examination. Roentgenograms of the atlas and axis were taken and an "old fracture of the odontoid process with dislocation of the atlas on the axis" was reported. The blood count, urinalysis, and blood serology were negative. He again refused operation and was discharged on April 4, 1936.

Case 2. R. W., a white female, aged 53, with the chief complaint of weakness of the right leg, was admitted Nov. 7, 1928, to the service of Dr. William G. Spiller in the University Hospital.

About one year prior to admission the patient first noted a lack of confidence in the use of her right lower extremity after considerable exercise. During the next six

Fig. 1. Case 1. Showing the fracture-dislocation and marked displacement of the atlas on the axis.

months this difficulty slowly progressed. She found it difficult to keep a soft cloth slipper on this foot. In walking along a dusty road, she noted that the top of her right shoe became covered with dust, and the right leg seemed to be thrown forward in walking. There was some difficulty in getting into bed because of the weakness of the right leg, and when in bed she was not able to turn as well as before. A gradual loss of strength and slight emotional instability had been noted.

About three months before admission there appeared some difficulty in the use of the right hand in writing. The writing movements became jerky, the writing was almost illegible, and the patient was rather reluctant to use her right hand. She complained of an inability to hold objects readily in this hand, and occasionally she had spilled liquids from tumblers and cups. For some time she had complained of numbness in the tips of the fingers of both of her hands.

About five years before the onset of these neurological disturbances, the patient was thrown from her horse, striking the back of her head upon a rock. She was taken

home unconscious but soon thereafter walked upstairs to her room and called her husband on the telephone. When he arrived he found her unconscious. She had no recollection later of having called him. After about three-quarters of an hour of semi-stupor she regained consciousness. She had a slight headache for a few days but never complained at any time of any pain in the neck or back of the head. Her husband dated the onset of her emotional upset to this event. She led her usual active life until the onset of the symptoms described above, five years after the accident.

Past medical history, family history, and social history were unimportant.

Physical Examination.—Revealed an abnormal prominence of the upper thoracic vertebræ causing a slight protrusion in this area. There was no stiffness in the movements of the neck. The examination was otherwise negative.

Neurological Examination.—(Dr. William G. Spiller.) The mental status and cerebellar and sensory examination were entirely normal. The cranial nerves presented no abnormalities. The muscle power in the right lower extremity was diminished as compared to the left. Weakness of the right upper limb could not be detected objectively.

Reflexes	Right	Left
Biceps and triceps—	somewhat exaggerated on both sides	
Patellar and Achilles—	slightly more prompt	normal
Ankle colonus—	absent on both sides	
Babinski—	present	absent

Course.—Examination of the optic fundi revealed no pathological changes. The visual fields were entirely normal. On Nov. 7, 1928, Dr. Temple Fay attempted an encephalogram. As the operation proceeded it became evident that a blockage of the subarachnoid space must exist, for only 67 c.c. of fluid were obtained. In addition, each introduction of air caused severe pain at the base of the skull and in the neck. The usual roentgenograms of the head were taken, as well as some films of the upper cervical region in an effort to demonstrate an air level.

The cerebro-spinal fluid was clear and colorless and was under an initial pressure of 10 mm. of mercury. There were 5 lymphocytes per cubic millimeter and 200 erythrocytes. The total protein content was 44 mgm. per cent. There was a slight decrease in the sugar content. The Wassermann reaction was negative and the colloidal gold test was read as 0000131100.

The initial examination of the roentgenograms taken following the unsuccessful encephalogram reported: head negative; pituitary fossa within normal limits of size (anteroposterior 8 mm., depth 10 mm.); no air could be demonstrated in the cisterna magna; the upper five cervical vertebræ were negative. Because of the evidence of a block in the subarachnoid space, further roentgenograms of the upper cervical vertebræ were taken, and the previous films were studied more carefully. The following report was returned: fracture dislocation of the atlas on the occiput; the odontoid process was fractured but the fragments were in good position; slight posterior and lateral dislocation of the head on the cervical spine.

The patient was transferred to the Neurosurgical service of Dr. Charles H. Frazier in the University Hospital. On Nov. 15, 1928, a laminectomy was performed with the removal of the laminæ of C1 and C2. From Dr. Frazier's operative notes we secure this interesting observation: there was no evidence whatever of any constriction or anything to impede the passage of fluid or air into the cranial cavity; the dura and the arachnoid seemed thickened and the arachnoid somewhat opaque. The spinal cord appeared to be normal. The post-operative course was uneventful except for a mild pyelitis. On discharge from the hospital on Dec. 6, 1928, a neurological examination revealed no evidence of improvement.

On several occasions throughout the following years the patient has communicated her status to the physicians in charge of her case. At first there was some im-

provement. The patient was able to walk without the use of a cane. Her handwriting improved. Only when she was greatly fatigued did the right lower extremity afford her any difficulty. The last report (1934) indicated that the neurological manifestations had remained fairly stationary since the slight post-operative improvement and had shown no tendency to become worse. The slight difficulty in the use of the right upper and lower extremities persisted, especially when she was fatigued. The Babinski sign was still present on the right. The patient led an active life and was not greatly inconvenienced by these infirmities.

NEUROLOGICAL CONSIDERATIONS

From the point of view of the neurological differential diagnosis both of the cases are interesting and instructive. The first case was particularly puzzling because of the lack of any history of trauma until the diagnosis had been confirmed by the roentgenogram. Before the roentgen findings were reported and the history of the traumatic incident was secured, it was necessary to run through the whole gamut of possible causes of spastic paraplegia. After all these had been eliminated, it was only because of the insistence of proper examination of the entire vertebral column in cases of unknown spastic paraplegias that a diagnosis was secured.

In the second case the history of the accident was obtained at the outset, yet there were no localizing signs or symptoms to suggest a dislocation of the occiput on the atlas. Here again the diagnosis rested upon roentgenologic evidence.

The most unusual features of the two cases were: (1) the long latent period between the original accident and the onset of the neurological symptoms, and (2) the insidious onset and slow development of the disturbances of the nervous system. Nowhere in the literature have we been able to find a case of fracture dislocation in the region of the atlas and axis with such a prolonged latent period. One of our cases began to develop symptoms 18 years after his fall. The symptoms started insidiously, progressed very slowly over six years and have remained stationary by clinical tests for the past two years. The second patient began to have symptoms four or five years following the accident. Her symptoms progressed slowly over a period of a year or so. This brings up the question of the pathological process operative in these cases.

Several causes for delayed neurological manifestations in fracture-dislocations of the atlas and axis have been described by numerous authors writing on the subject. These are, briefly: redislocation—Elliott and Sachs (6), Naegeli (7), von Kienböck, *et al.;* progressive dislocation—Kahn and Yglesias (8); excessive callus formation—Osgood and Lund(1), Bernstein (4); pachymeningitis and pressure—Blaine (9); myelitis—Jackson (3); irritation of abnormal mobility—Osgood and Lund (1); late development of an osteomyelitis—Osgood and Lund (1).

A study of the histories of the reported cases revealed certain distinct differences between them and our two patients. In the former the period of latency varied from several days to eight months. In our cases this asymptomatic period was several years. In the previously reported cases the development of the neurological symptoms was usually very rapid. A few took several months to become complete, but none had the insidious onset and slow progress that we found in our cases.

The suggestion of Jackson (3) that a myelitis may develop many years after the accident, and the hint as to the process in the operative observation of thickening of the meninges in the second case suggested to us that we were dealing with some sort of post-traumatic meningomyelitis. Circumscribed adhesive spinal arachnoiditis has as its chief characteristic feature an insidious onset, a slow development, and a prolonged progression of the neurological picture. This condition has been called by many other names—Cadwalader (10), Wortis (11). The condition consists of

several different gross pathological pictures. There may be: arachnoidal cystic formation—Spiller (12), Barré (13), *et al.;* adhesions scattered diffusely along the surface of the spinal cord without cyst formation—Stookey (14); masses of arachnoidal adhesions or cysts with more or less ossification, even up to a complete bony plaque, "arachnoiditis ossificans"—Puusepp (15).

The etiological factor in these cases has often been considered to be due to infections elsewhere in the body. However, Armour (16), Foerster (17), Brouwer (18), Mauss and Krüger (19), and others stress the importance of the rôle of trauma in the production of the arachnoidal changes.

The actual pathogenesis of the neurological disturbances has not been definitely determined. In 1926, Stookey (14) considered the adherent arachnoid as anchoring the spinal cord at one point. Because of the normal movements of the spinal cord, he pointed out that a mild trauma was continually exerted at this one fixed point. Thereby, disturbance of cord conduction slowly developed. Others have considered that the arachnoidal and pial proliferations might slowly produce changes in the blood supply of the cord that would result in secondary softenings and degenerations of the conduction systems. In the cystic and ossified forms, direct pressure is the important factor according to Puusepp (15).

That there may be intramedullary changes with a leptomeningitis has been shown by the autopsy findings in a case of Brouwer (18). The chief findings in his case were: (1) pachy- and lepto-meningitis; (2) absence of changes in the cells of the gray matter of the spinal cord; (3) a "randmyelitis." He tends to agree with Mauss and Krüger (19) that these changes may well be due to vascular disturbances from arachnoidal adhesions encroaching on the vessels.

The seventh case of Brouwer (18) furnished us with still further evidence as to the process operative in our cases. Because of this we review it here in some detail: A male, aged 37 years, had a severe accident in which he fractured the base of his skull, several thoracic vertebræ, and certain of his extremities. Nine years later he began to have pain about the umbilicus and down both legs and a burning sensation in his feet. Thirteen years later he noted weakness in the right leg, and in the following year his left leg became weak. The roentgen examination of the vertebræ showed an old fracture in the region of the tenth, eleventh, and twelfth thoracic vertebræ. Eighteen years after the accident the patient presented a spastic paraplegia limited to the lower extremities and definite sensory disturbances below the level of the umbilicus. A Queckenstedt test revealed only a slight block. This was localized by means of lipiodol. A laminectomy was performed, and at the level of the eleventh thoracic vertebræ the surgeon found a circumscribed pachymeningitis. The under side of the dura was smooth. The arachnoid was darkened, edematous, and gelatinous. It separated easily from the spinal cord, which appeared normal. The diseased meninges were removed and the patient recovered remarkably well. His pain disappeared and his locomotion improved so that he was able to walk about with the aid of a stick. The patient remained well for three years. He then began to have pains in his legs and about his anal region, though his ability to walk was not greatly altered from his previous state. Lumbar puncture showed partial block and the patient was treated with diathermy.

It would seem, therefore, that the neurological picture of these two cases of fracture dislocation in the region of the atlas and axis may well be explained on the basis of the development of a post-traumatic spinal arachnoiditis in the cervical region.

DISCUSSION

Neurological syndromes of this type suggest investigation of the atlanto-axial region. In one of our cases the roentgenographic evidence stood alone as a diagnostic aid, and the significant history of injury was not elicited until after insistent

direct inquiry, although a complete systemic review and past history had been previously obtained.

The second case illustrates the possibility of failure in demonstration of the essential pathology by the routine roentgen examination, and serves to emphasize the value of repeated study when other causes of the obscure neurological findings are not revealed.

There are many difficulties inherent in the anatomical features of the upper cervical region. It is necessary, therefore, for the radiologist to be meticulous in such examinations.

Decalcification of the odontoid process may occur at the site of the fracture probably as a result of a fibrosing osteitis. In suspected fracture of the dens the roentgen examination should be repeated in three months. We have seen fracture without displacement which was not detected until the roentgen examination revealed the rarefied appearance of absorption. This zone becomes more pronounced in old fractures, especially if the patient has had no fixation of the neck following the injury. Callus formation does not occur.

Fracture of the dens in adolescence may simulate the appearance usually found in developing bone. Therefore, one should exclude the appearance of an epiphysis which normally occurs at the base of the epistropheus.

The radiologist and neurologist should be conversant with the possible development of latent manifestations because of its importance in compensation cases.

SUMMARY

Two cases of fracture-dislocation in the region of the atlas and axis are reported. Neurological manifestations occurred after a lapse of 18 years in the first and five years in the second.

Emphasis is placed upon the fact that in all uncertain cases of spastic paraplegia, even without a history of trauma to the neck, or without local signs, and although the nervous symptoms and signs are far removed in time from a known injury, thorough roentgen examination of the atlanto-axial region should be performed.

BIBLIOGRAPHY

(1) Osgood, R. B., and Lund, C. C.: Fractures of the Odontoid Process. Trans. New Eng. Surg. Soc., 1928, **10,** 196–223. Also New Eng. Jour. Med., 1928, **198,** 61–72.

(2) Ogilvy, C.: Subluxations of Atlas on Axis. Am. Jour. Orthop. Surg., 1914–1915, **12,** 314–331.

(3) Jackson, R. H.: Simple Uncomplicated Rotary Dislocation of the Atlas. Surg., Gynec. and Obst., 1927, **45,** 156–164.

(4) Bernstein, R.: Zur Diagnose und Prognose der Rückenmarksverletzungen. Ein Fall von Luxation mit Fraktur des Epistropheus. Deut. Zeit. f. Chir., 1903, **70,** 175–182.

(5) Ely, L. W.: Subluxation of the Atlas: Report of Two Cases. Ann. Surg., 1911, **54,** 20–29.

(6) Elliott, G. R., and Sachs, E.: Observations on Fracture of the Odontoid Process of the Axis with Intermittent Pressure Paralysis. Ann. Surg., 1912, **56,** 876–882.

(7) Naegeli, T.: Atlasluxation nach vorn mit Fraktur des Zahnfortsatzes des Epistropheus. Spätlähmung und Ausgang in Heilung. Deut. Zeit. f. Chir., 1919, **148,** 269–275.

(8) Kahn, E. A., and Yglesias, L.: Progressive Atlanto-axial Dislocation. Jour. Am. Med. Assn., 1935, **105,** 348–352.

(9) Blaine, E. S.: Manipulative (Chiropractic) Dislocations of the Atlas. Jour. Am. Med. Assn., 1925, **85,** 1356–1359.

(10) Cadwalader, W. B.: Diseases of the Spinal Cord. Circumscribed Adhesive Spinal Arachnoiditis, pp. 128–129. Williams & Wilkins Co., 1932.

(11) Wortis, S. B.: Nelson Loose-leaf Medicine, **6,** pp. 547J and 547K, Thomas Nelson & Sons, New York.

(12) Spiller, W. G.: Circumscribed Serous Spinal Meningitis: A Little Recognized Condition Amenable to Surgical Treatment. Am. Jour. Med. Sci., 1909, **137,** 95–97.

(13) Barré, J. A.: Étude sur l'arachnoidite Spinale et l'arachnoidite de la Fosse Cérébrale Postérieure. Rev. Neur., June, 1933, pp. 879–918.

(14) Stookey, B.: Adhesive Spinal Arachnoiditis Simulating Spinal Cord Tumor. Trans. Am. Neur. Assoc., 1926, pp. 129–156. Also Arch. Neur. and Psych., 1927, **17,** 151–178.

(15) Puusepp, L.: Surgical Intervention in Four Cases of Myelitis Compression Caused by Osseous Deposits in the Arachnoidea of the Spinal Cord (Arachnoiditis Ossificans). Jour. Nerv. and Ment. Dis., January, 1931, **73,** 1–19.

(16) Armour, D.: On the Surgery of the Spinal Cord and its Membranes. Lecture II. Trans. Med. Soc. London, 1927, **50,** 152–210.

(17) Foerster, O.: Die Traumatischen Läsionen des Rückenmarkes auf Grund der Kriegserfahrungen. (Der Mechanismus ihres Zustandekommens und die pathalogischanatomischen Veränderungen)—Die Meningopathien. Lewandowsky's Handbuch der Neurologie, Second Part. Julius Springer, Berlin, 1929, **4,** 1793–1803.

(18) Brouwer, B.: Ueber Arachnoiditis Adhaesiva Circumscripta. Deut. Zeit. f. Nervenheilk., 1931, **117–119,** 38–66.

(19) Mauss, T., and Krüger, H.: Ueber die unter dem Bilde der Meningitis Serosa Circumscripta verlaufenden Kriegsschädigungen des Rückenmarks und ihre operative Behandlung. Deut. Zeit. f. Nervenheilk., 1918, **62,** 1–116.

NON-TRAUMATIC DIAPHRAGMATIC HERNIA

WITH A REPORT OF A CASE OF CONGENITAL RIGHT-SIDED HERNIA

By CAMP C. THOMAS, M.D., *Lewiston, Maine*

Roentgenologist, St. Mary's General Hospital, Lewiston, Maine, and Visiting Roentgenologist, St. Louis Hospital, Berlin, N. H.

A LARGE number of diaphragmatic hernias have been reported in the literature, in the past 26 years, and it is quite noticeable that the number has markedly increased in the last decade due to the increasing number discovered by routine roentgenologic examinations. Prior to the past ten years, the literature concerning congenital hernia was largely limited to cases found at autopsy or incidental findings during abdominal operations. By far the greatest number reported were due to trauma. The percentage of right-sided hernias reported is very small compared with those found on the left side.

Kerr and Steinberg, in reporting three cases of right-sided hernias, cited Eppinger, whose series of 635 cases of diaphragmatic hernia included 55 hernias of the right side, or about 9 per cent. These cases were based on figures of v. Thoma, Locker, Grosser, Wolf, v. Grossnitz, B. Schmidt, and Iselin.

Hedblom, in listing the locations of hernial openings in 728 cases including his own and those specifically mentioned in the collected series of Lacher, Grosser, Richards, Greenwald, and Steiner, shows about 12 per cent of the non-traumatic to be right-sided.

Eight thousand autopsies at Johns Hopkins Hospital, reviewed by James White, disclosed only one case of right-sided hernia. Breckoff, in reviewing the German literature, found only two cases previously reported and adds his own case. Carman and Fineman, in 1924, reported 20 cases of non-traumatic hernia, all through the esophageal hiatus, discovered in 1,800 examinations. Truesdale reports a case of right-sided hernia in a boy of five, unsuccessfully operated on by Aue, of Leipzig, in 1920. William G. Herrman reports an interesting case in which the pyloric end of the stomach and the duodenum were herniated through the right foramen of Morgagni. Remo Porta (Milan) reports a case of right-sided hernia which he believes was congenital, although it was not proven by autopsy or operation.

Dodds and Pocock, in reporting a right-sided diaphragmatic hernia in a baby living but 30 minutes after birth, cites J. C. Latta, who reviewed 127 cases of diaphragmatic hernia in which number the age was given in 112 cases. Of this number, 88 were still-born or died within a few hours after birth. The same authors refer to Popp, who reported 42 cases of hernia, only five of which were on the right side.

The only case we could find in the literature similar to the one we are reporting was a case of hernia of the colon and omentum through the right foramen of Morgagni, reported by Hedblom. In addition to the hernia, our case has unusual congenital anomalies.

Etiology.—There are five morphologically weak spots in the diaphragm through which congenital or acquired hernias usually occur right and left parasternal openings (foramen of Morgagni), the right and left pleuroperitoneal openings (foramen of Bochdalek), and the esophageal hiatus (Fig. 1). In addition to these normally weak areas, there may be a congenital absence of part or all of the diaphragm. A study of the embryological development of the diaphragm makes clear the possible points of herniation. C. Latimer Callander in his text book of surgical anatomy states briefly and clearly the development of the diaphragm, and we quote him *verbatim:*

"The diaphragm arises from five morphological elements—the central tendon, two ventrolateral, and two dorsal parts. The cen-

tral tendon is formed from the transverse septum, an embryonic layer of tissue separating the heart from the liver. The ventrolateral

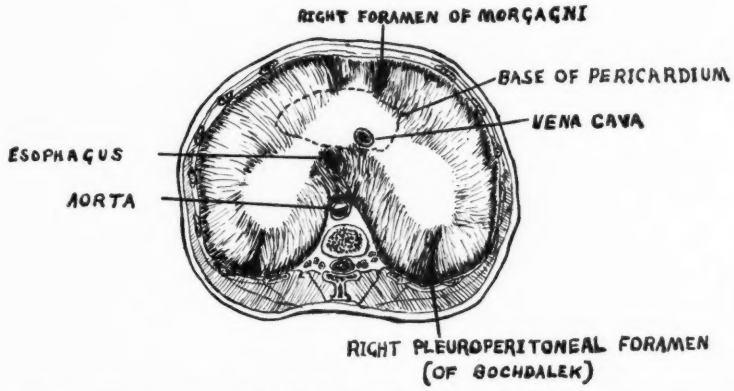


Fig. 1. Thoracic view of the diaphragm showing the relative positions of some of the "weak spots" through which the usual congenital hernias occur.

portions of the diaphragm arise from the ventrolongitudinal muscle layer of the body. The dorsal portions are derived from the paravertebral musculature. These segments fuse and leave a pleuroperitoneal foramen on each side posteriorly between each dorsal and corresponding ventrolateral part. These apertures close early in fetal life by a fusion of their margins."

We may, therefore, expect to find a hernia at any point along the line of fusion of the anlagen. The question as to whether a hernia is congenital or acquired may in some cases precipitate an academic debate; however, authors in general agree that the congenital hernia is present at birth and generally has no sac, and the acquired develops because of a congenital weakness and generally has a sac. With the presence of a morphological weakness, the contributing causes of acquired hernias may consist of anything which greatly increases the intra-abdominal pressure, such as pregnancy, violent coughing or vomiting, straining at stool, intestinal obstruction, weight-lifting, falls, blows on the abdomen, etc.

Symptomatology.—The symptoms may be vague and confusing. We have listed a few of these cited in the literature, as follows: eructations after eating, epigastric pains, colic and burning, nausea, cardiac distress, cyanosis, and dyspnea. Symptoms may simulate ileus, peptic ulcer, gallbladder disease, heart and lung pathology. There may be a very large defect in the diaphragm without any clinical symptoms. Truesdale refers to Newcomet, who reported a case of congenital hernia in a young athlete who had a large portion of his intestinal tract in the thorax, yet did not complain of serious trouble till he was 17. The diagnosis was not made till two years later when it was revealed by roentgenologic examination.

Roentgen Diagnosis.—Non-traumatic hernia is rarely diagnosed without the aid of the x-ray. Fluoroscopic and film examinations without contrast media may suggest the diagnosis. The "intestinal pattern" in the lung-field may be conclusive evidence. The barium meal and enema, with the patient in different positions on the tilting fluoroscopic table, probably give the most useful information. Our routine in gastrointestinal examinations is to scrutinize the thorax first, and then have the patient swallow about two ounces of thick paste composed of barium and water. The writer has often seen the value of this paste demonstrated in visualizing diverticula of the esophagus and herniation of the fundus of the stomach through the esophageal hiatus. It is also better than the fluid meal in studying the rugæ. A meandering esopha-

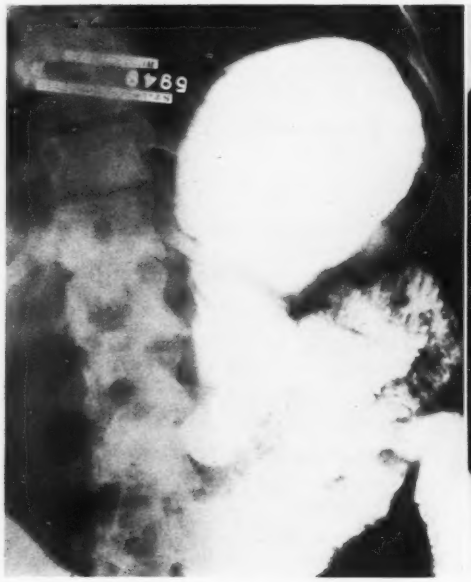


Fig. 2. Fig. 3.

Fig. 2. Showing stomach and duodenum pushed toward the left, and rapid emptying after the barium meal.

Fig. 3. Ten-hour examination.

gus, one which gives you the impression that it is longer than normal, may prove to be a hernia of the cardiac end of the stomach through the esophageal hiatus. Often when the head of the table is lowered, as was suggested by Carman, the viscus may be gently forced through the hernial opening. If this procedure were carried out routinely, probably more cases of hernia would be discovered during the usual gastro-intestinal examinations.

Differential Diagnosis.—(1) Eventration (paralysis of part or all of one side of the diaphragm) often may be confusing. Sante suggests the use of pneumoperitoneum to locate the position of the diaphragm. Kirklin points out that in eventration the contents of the stomach show a level at the hiatus, while in hernia it is apt to be above it. Dickson says that defective embryologic development of the hepatic flexure may simulate eventration. Hans Fritsch cites some of the diagnostic points in a report of a case. (2) Congenital absence of the diaphragm: This appears to be of academic importance only because it represents a total defect in development instead of a partial defect as in congenital hernia. (3) Cardio-esophageal relaxation often noted by Kirklin, who cites a report of 100 cases by Robin and Junkelson. (4) Diverticulum of the esophagus and the thoracic stomach as listed in reporting a case by Elward. (5) Lung cysts, bronchiectases, hydropneumothorax, subdiaphragmatic abscess, and echinococcus cysts of the liver and the lung. (6) Openings caused by malignancy and tuberculosis.

The case we are reporting is interesting because of its rarity and its successful treatment.

Case Report.—A. N., white female, aged 41, referred by Dr. J. E. Larochelle, of Berlin, N. H. Family history was irrelevant. No history of injury. Mother of 12 children, living and well. Four years ago, she gave birth to a dead fetus by breech presentation, and the labor was difficult. She had pertussis and pneumonia in early childhood. Health since childhood was good till about two years ago. Menstruations normal. Constipated for

several years. Patient was referred to the hospital two years ago for Graham test. The gall bladder functioned normally.

At this time, she was referred to the hospital for gastro-intestinal examination to rule out peptic ulcer. She was complaining of dyspepsia, pain in epigastric and right hypochondriac regions, eructations of gas, and a feeling of distention after meals. No nausea. Slight loss of weight due to restricted diet. Patient said that she was comfortable as long as she did not eat. The week prior to entering the hospital, her diet consisted of fluids only.

Physical Examination.—Well-nourished, sthenic type, white female. Temperature, 98; pulse, 72; respiration, 20; blood pressure, 140 systolic, and 70 diastolic. Head (including ear, nose, throat, and mouth) normal except for edentuous jaws. Urine, blood count, blood urea and sugar, normal; van den Bergh test negative. Right thorax showed limited respirations, and tympanites over base of lung. Heart normal. Pain and tenderness in upper right abdomen.

Roentgen Examination.—Fluoroscopic examination of the thorax showed restricted excursions and irregular outline of the right diaphragm. The lung-fields were clear except for increased density above the irregular and indistinct right diaphragm. The heart and mediastinum appeared normal. The stomach and duodenum were pushed toward the left (Fig. 2). The stomach was normal except for hypermotility and hyperperistalsis. The ten-hour examination (Fig. 3) showed the colon completely filled, with part of the transverse portion in the anterior right thorax. The colon was pushed to the left and downward by what appeared to be an enlarged liver, extending below the crest of the ilium. The barium enema gave additional information by showing what took place when the colon was well distended (Fig. 4). The heart and lower mediastinal structures were displaced to the left while the patient was supine. At this point in the examination the patient complained of severe pain and difficulty in breathing. Much less of the gut was seen above the diaphragm while the patient was standing. The ileocecal valve was incompetent.

Fig. 4. Barium enema. Shows displacement of heart and lower mediastinal structures toward the left.

Surgical Findings and Treatment.—The operation was performed by Dr. Larochelle. A costo-marginal incision was made on the right side extending from the zyphoid process to the eleventh cartilage. Muscles were incised and the peritoneum opened. As soon as the abdominal cavity was opened, a portion of the colon began to recede from the hernial opening. All of the omentum and the rest of the colon were easily delivered with slight traction. The opening, about an inch and a half in diameter, was through the foramen of Morgagni. There were no signs of adhesions or scar tissue. There was no hernial sac. The liver was ptosed and rotated about ninety degrees so the left lobe extended into the right pelvis (Fig. 5). The usual diaphragmatic surface of the liver was completely covered with peritoneum. The suspensory ligament was represented by a long delicate string of peritoneum. The size of the liver was normal. The gall

bladder appeared normal. The hernial opening was closed by purse-string sutures of silk and covered by mattress sutures.

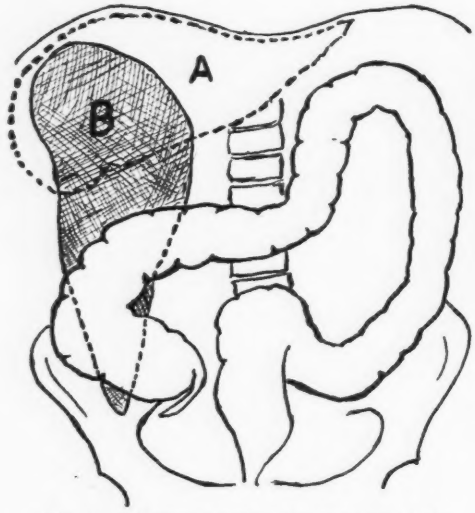


Fig. 5. Diagram showing the position of the liver (*B*) as it was found at operation. Left lobe is in the right pelvis.

No attempt was made to change the position of the liver. The patient was dyspneic and cyanotic for three or four days after the operation; otherwise, the clinical progress was uneventful, and she was discharged well at the end of 18 days. The patient was examined three months after the operation. She had had no recurrence of her symptoms, and the x-ray examination was negative (Fig. 6). There was no evidence of atelectasis or diaphragmatic adhesions.

Discussion.—Reports of non-traumatic hernia of the right diaphragm are rare and in the majority of cases the condition has been found at autopsy or during abdominal surgery. Most of the cases reported are of infants. Some writers explain the rarity of this type of hernia as being due to the liver acting as a "buffer" during intra-abdominal pressure. Hedblom and others claim that this is not an adequate explanation. We believe this case to be congenital because there was no hernial sac, no adhesions, no scar tissue. There was an anomalous position of the liver with an anomalous suspensory ligament, and no fixation of the hepatic and splenic flexures. There was no history of unusual trauma.

Fig. 6. Barium enema given three months after the operation.

Twelve normal pregnancies and one difficult labor might lead one to consider them as etiologic factors; however, one must consider the fact that there were no clinical symptoms till two years after the last childbirth. There were no unusual clinical symptoms following pertussis. The anomalous position of the liver offers no difficulties. It is not unusual for congenital defects to cause clinical symptoms only after middle life.

Summary.—We have reviewed some of the literature on diaphragmatic hernia with special reference to right-sided non-traumatic types.

A report of a congenital right-sided diaphragmatic hernia through the foramen of Morgagni and unusual congenital anomaly of the liver.

The roentgenologic and surgical findings, and treatment.

The writer wishes to acknowledge his indebtedness to Dr. J. E. Larochelle, of

Berlin, N. H., for his surgical notes, and to the laboratory assistants for their kindness in collecting the laboratory and history data.

REFERENCES

1. AUE, O.: Deutsche Ztchr. f. Chir., November, 1920, **160** (reported by P. E. Truesdale).

2. BRECKOFF, K.: Zur Kasuistik der rechtsseitigen Zwerchfellhernien. Röntgenpraxis, April, 1933, **5**, 257, 258 (reported by Kerr and Steinberg).

3. CALLANDER, C. LATIMER: Surgical Anatomy, published by W. B. Saunders Co., p. 335.

4. CARMAN, R. D., and FINEMAN, S.: Roentgenologic Diagnosis of Diaphragmatic Hernia. RADIOLOGY, July, 1924, **3**, 26–45.

5. DODDS, GLADYS, and POCOCK, J. A.: Right-sided True Diaphragmatic Hernia, with Unusual Features. Arch. Dis. Child., June, 1930, **5**, 233–235.

6. DICKSON, M. H.: Diaphragmatic Hernia. Canad. Med. Assn. Jour., July, 1933, **29**, 24–31.

7. ELWARD, J. F., and OTELL, L. S.: Non-traumatic Diaphragmatic Hernia. Am. Jour. Roentgenol. and Rad. Ther., 1929, **22**, 535–542.

8. ELWARD, J. F.: Diaphragmatic Hernia and Diverticulum of the Esophagus. Am. Jour. Roentgenol. and Rad. Ther., September, 1936, **36**, 305–308.

9. EPPINGER, H.: Allgemeine und Spezielle Pathologiedes Zwerchfells. Nothnagel's Pathologie u. Therapie, Suppl. 1, 1911, p. 132 (cited by Kerr and Steinberg).

10. FRITSCH, HANS: A Case of Right-sided Relaxation of the Diaphragm. Am. Jour. Roentgenol. and Rad. Ther., October, 1930, **24**, 430–432.

11. HEDBLOM, CARL A.: Parasternal Diaphragmatic Hernia. Surg. Clin. N. Am., April, 1924, **4**, 543–556.

12. Idem: Diaphragmatic Hernia: Study of 728 Cases in which Operation was Performed. Jour. Am. Med. Assn., Sept. 26, 1925, **85**, 947–953.

13. HERRMAN, W. G.: Case of Right-sided Atypical Diaphragmatic Hernia. RADIOLOGY, 1934, **22**, 241–246.

14. KERR, H., DABNEY, and STEINBERG, S. S.: Right-sided Diaphragmatic Hernia, with a Report of Three Cases. Am. Jour. Roentgenol. and Rad. Ther., December, 1935, **34**, 735–739.

15. KIRKLIN, B. R.: Progress in Roentgenologic Diagnosis of Diaphragmatic Hernia. Proc. Staff Meet., Mayo Clinic, July 16, 1930, **5**, 197.

16. PORTA, REMO (Milan): Case of Right-sided Diaphragmatic Hernia. Radiol. med., April, 1936, **23**, 255–262.

17. RABBINOVITZ, M., and ZOPPINO, L.: Un cas de hernie diaphragmatique droite vraie, congenitale. Schweiz. med. Wchnschr., Dec. 18, 1924, **54**, 1181–1184.

18. SANTE, L. R.: The Chest: Annals of Roentgen., Vol. XI, p. 143, published by Paul Hoeber.

19. TRUESDALE, P. E.: Diaphragmatic Hernia in Children, with a Report of Thirteen Operative Cases. New Eng. Jour. Med., Dec. 12, 1935, **213**, 1159–1172.

20. WHITE, J. C.: Right-sided Diaphragmatic Hernia. Johns Hopkins Hosp. Bull., September, 1925, **37**, 203–213.

CASE REPORTS AND NEW DEVICES

AN UNUSUAL CASE OF HODGKIN'S DISEASE OF THE LUNG

By SIDNEY RUBENFELD, M.D., *and* EUGENE CLARK, M.D., *New York City*

From the Department of Radiation Therapy and the Laboratories of Pathology, Bellevue Hospital

The involvement of the lung by Hodgkin's disease is well recognized, and its pathologic and roentgenologic features have been reviewed in several recent papers.(1–4) The following case appeared to be of unusual interest, since the limitation of clinical signs to the lungs for five years suggested a pulmonary origin of the disease. The roentgenologic features of the case were reported by one of us (S. R.) in 1934 (5). The nature of the lesion was then unknown, but it has been subsequently established by biopsy and necropsy.

CASE REPORT

J. W., aged 42, white, a meter worker, American, complaining of pain in the region of the left shoulder, was admitted to the Radiation Therapy Service of Bellevue Hospital in June, 1932. His illness had begun two years previously, with the simultaneous occurrence of a dry hacking cough and a dull ache in the lower dorsal area which radiated to the left scapular region and the left shoulder. These symptoms persisted for two years without aggravation. He neither coughed blood nor had night sweats. During the four months prior to admission he had lost 15 pounds.

He appeared well developed and well nourished. There was dullness and numerous coarse bronchial râles in the left upper chest heard posteriorly. The Wassermann reaction was negative, and the blood count was entirely

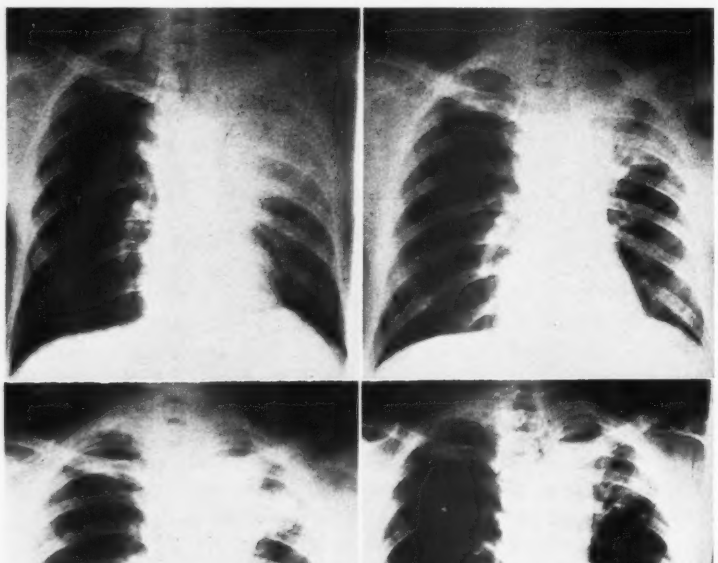


Fig. 1 (*upper left*). Jan. 8, 1932.
Fig. 2 (*upper right*). Aug. 3, 1932, after 3,200 r.
Fig. 3 (*lower left*). Aug. 26, 1932.
Fig. 4 (*lower right*). Sept. 2, 1932, after 3,200 r.

normal. A radiograph had been taken elsewhere in January, 1932, which showed a homogeneous decrease in illumination of the upper half of the left lung field, slight elevation of the left dome of the diaphragm, and widening of decrease in density of the mass (Fig. 2). Although fibroid pulmonary tuberculosis was then suspected, several sputum examinations failed to disclose the presence of tubercle bacilli.

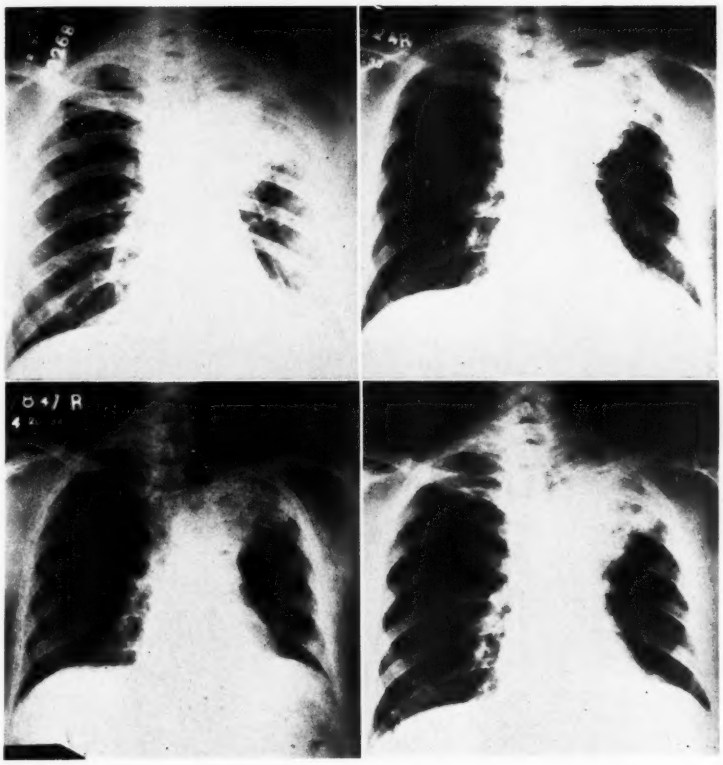


Fig. 5 (*upper left*). Feb. 20, 1933.
Fig. 6 (*upper right*). July 6, 1933, after 1,600 r.
Fig. 7 (*lower left*). Jan. 25, 1934.
Fig. 8 (*lower right*). April 4, 1934, after 2,400 r.

the mediastinum to the right (Fig. 1). On bronchoscopy, the left upper bronchus was found plugged with thick tenacious exudate; after its removal, a normal mucosal surface was disclosed. A bronchogram disclosed failure of filling in the left upper lobe.

In the absence of tissue biopsy, a clinical diagnosis of lung carcinoma was postulated and x-ray therapy was instituted. With 200 kv. 4 ma., using an open cone at 40 cm. distance, directed to the left lung anteriorly and posteriorly, 1,600 r was administered to each area.

Two months after the completion of this first series of treatments, the patient exhibited remarkable clinical improvement, and a radiograph taken at this time showed pronounced

Since the initial reaction was so satisfactory, another series of high voltage x-ray was administered in September, 1932, attacking the same areas and employing the same factors. At the end of this second series, a radiograph disclosed additional resolution of the tumor mass, with widening of the mediastinum and marked retraction of the trachea to the left (Fig. 4).

In February, 1933, there was a recurrence of the pain in the left chest and shoulder. The x-ray examination disclosed again a dense mass in the left upper chest, with tracheal retraction (Fig. 5). The area was again irradiated, giving 800 r as previously. Three months later, in April, 1933, the pain was entirely gone and the patient's general condition

remained good. However, the x-ray film of July, 1933 (Fig. 6), presented no striking alteration.

During the next six months the patient did not return to the clinic, being free from all symptoms. He re-appeared in January, 1934, when the dull shoulder ache returned. The x-ray film was similar to previous films but, in addition, showed evidence of cavitation (Fig. 7). Treatment was again instituted, giving 1,200 r to the anterior and posterior upper chest. Again, the tumor mass resolved, the shoulder pain subsided, and improvement in the general condition occurred, although there was no significant change in the x-ray films (Figs. 8, 9, and 10).

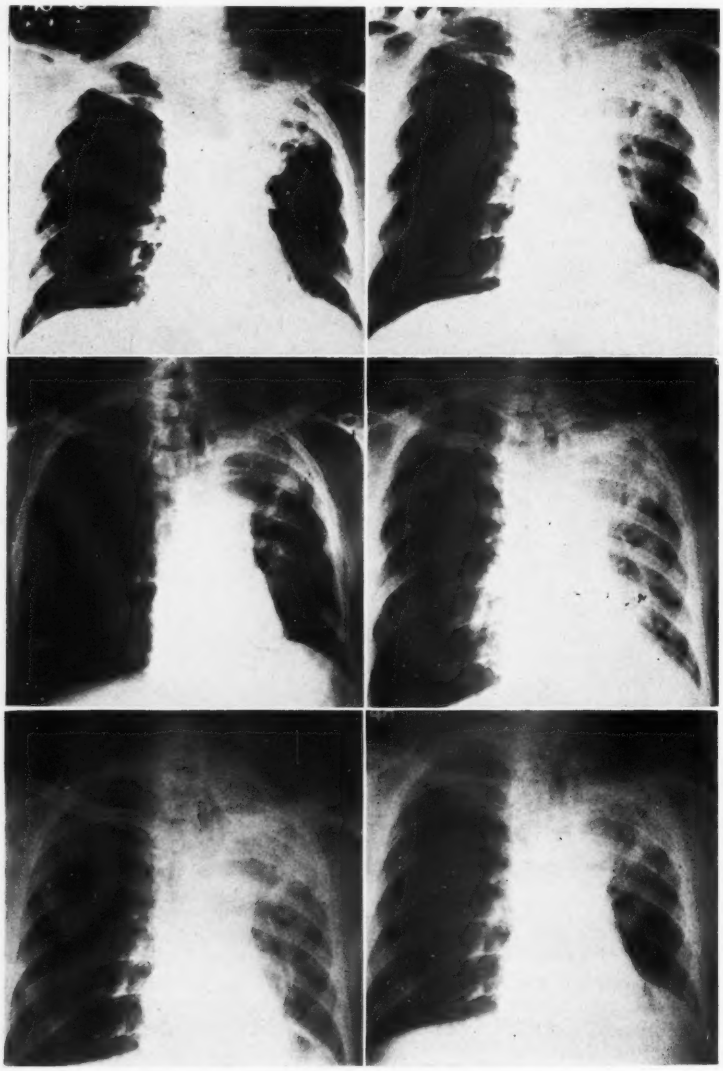


Fig. 9 (*upper left*). June 15, 1934.
Fig. 10 (*upper right*). Oct. 5, 1934.
Fig. 11 (*middle left*). Dec. 21, 1934, after 2,400 r.
Fig. 12 (*middle right*). Mar. 13, 1935, after 2,400 r.
Fig. 13 (*lower left*). April, 1935.
Fig. 14 (*lower right*). May 6, 1935.

The Summer of 1934 found the patient absolutely symptom-free. In October a nonproductive brassy cough appeared, and was accompanied by palpitations and an afternoon fever of 100°. In December, the left scapular pain reappeared, and by February, 1935, the patient had lost 17 pounds. At this time, x-ray therapy was again instituted, giving 2,400 r to each area on the anterior and posterior chest walls. Remarkable improvement occurred, with a gain of seven pounds in weight and disappearance of symptoms. The roentgenographs showed slight reduction in the size of the mass, but retraction into the left lung became more pronounced after this series (Fig. 11). Then a diffuse haziness appeared in the

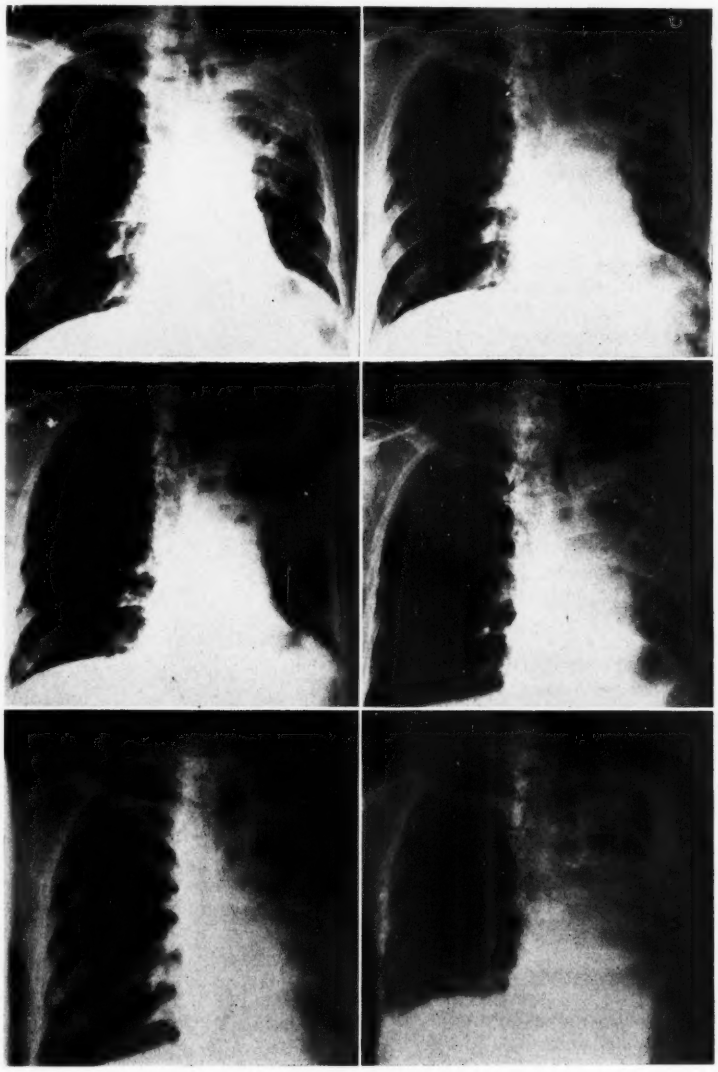


Fig. 15 (*upper left*). June 5, 1935.
Fig. 16 (*upper right*). July 31, 1935.
Fig. 17 (*middle left*). Aug. 20, 1935.
Fig. 18 (*middle right*). Dec. 20, 1935, after 2,400 r.
Fig. 19 (*lower left*). Feb. 10, 1936.
Fig. 20 (*lower right*). Aug. 7, 1936.

entire left chest and persisted for two months (Figs. 12, 13, and 14).

This latter series of treatment was followed with another less intense dose of 1,200 r to the anterior and posterior chests.

The next five months were uneventful. In November, 1935, there appeared sharp shooting pains in the right hip radiating down the thigh, and the brassy cough recurred. A roentgenogram of the bony pelvis revealed no pathologic changes. Treatment was given as previously, a dose of 1,800 r to the chest, anteriorly and posteriorly, and 1,300 r to the pelvis. The pain was soon relieved, and the cough moderated. At this time, facial pallor became evident, and blood analysis revealed a red blood cell count of 3,350,000 with 60 per cent hemoglobin. Following liver therapy, the count was 4,360,000 and the hemoglobin was 75 per cent.

A more dismal picture was evident in February, 1936, when weakness, loss of weight, cough, palpitations, and pain in the leg were again pronounced. Two transfusions were given within a month without effect. Edema of both legs and in the digits of the left hand made its appearance. In June, superficial adenopathy was noted in the neck and in the groin. The nodes were hard, discrete, fixed to the deeper structures, but not to the skin. Fever recurred and pruritus appeared. The diffuse haziness of the entire left chest reappeared (Figs. 19 and 20).

A biopsy of a cervical node was performed in August. The node presented, on histologic examination, a loss of normal architecture. There was a diffuse densely cellular infiltration of mononuclear and multinucleated giant cells, lymphocytes, and eosinophilic leukocytes. There were many areas of fibrosis and hyalinization.

Irradiation of the nodes at this stage proved futile. The patient sank rapidly, and succumbed in September, 1936, four years after admission to the hospital, and six years after the onset of the illness.

In brief, a 42-year-old man presented radiographic evidence of a mass in the left upper lobe which successively produced pain in the shoulder, cough, loss of weight, and fever. The mass exhibited a remarkable degree of radiosensitivity which was the deciding factor in altering a clinical diagnosis of lung cancer. Five years after the onset of the illness, superficial adenopathy appeared suggestive of Hodgkin's disease.

Significant Necropsy Findings.—The subject appeared pale and poorly nourished. Discrete firm lymph nodes, varying from 1 to 6 cm. in diameter, were palpated in the neck, axilla, and groin. The abdomen and right pleural cavity contained about 200 c.c. of clear amber fluid.

Fig. 21. View of the cut surface of the left lung; the arrow points to the cavity in the upper lobe.

The left pleural cavity was obliterated by dense adhesions and the left lung was removed by stripping the parietal pleura from the chest wall. The lung appeared about half its natural size and was enveloped by a dense pearly white membrane which measured up to 1 cm. in thickness (Fig. 21). The two lobes were densely adherent, and were dense and rubbery in consistency. The cut surface of the entire left lung presented a mottled grayish-white and black appearance with many dilated bronchi and bronchioles, and a thick-walled odorless cavity, about 4 × 3 × 2 cm., was encountered in the posterior portion of the upper lobe.

The right lung was natural except for the presence of several well-circumscribed firm grayish subpleural nodules up to 1 cm. in diameter.

The mediastinal lymph nodes were discrete and enlarged, but none exceeded 2 cm. in size. They appeared firm and grayish-white; a caseous focus was seen in one, a calcified focus in another.

The heart exhibited an acute fibrinous pericarditis.

The retroperitoneal, mesenteric, iliac, inguinal, and femoral nodes varied from 1 to 8 cm.

in size and presented a uniform firm grayish-white character.

The liver weighed 200 gm. and presented a well-circumscribed grayish-white nodule about 1 cm. in diameter situated in the right lobe. Three similar nodules showing central ulceration were found in the mucous membrane of the jejunum.

The rib marrow was red, but the vertebral bodies presented a striking gray appearance on section.

MICROSCOPIC FINDINGS

Lymph Nodes.—The normal elements of the nodes are replaced by tissue which varies widely in its cellular content and degree of fibrosis and hyalinization. The cellular pattern is pleomorphic and exhibits the following elements: mononuclear and multinucleated giant cells, eosinophilic and neutrophilic polymorphonuclear leukocytes, lymphocytes, plasma cells, histiocytes, and fibroblasts. The dominant cell varies in different fields and in many fields the giant cells appear particularly numerous. There are occasional foci of amorphous eosinophilic necrosis. The degree of fibrosis is most marked in the mediastinal nodes.

The nodules in the right lung, liver, and jejunum, and the vertebral marrow present a histologic picture similar to the lymph nodes.

Lungs.—Sections taken through the fused parietal and visceral pleura of the left lung exhibit dense fibrous tissue without cellular structure. The subjacent lung is made up of dense fibrous tissue containing a few epithelial-lined spaces, an occasional patch of intact alveoli, dilated and atrophic bronchi and bronchioles, and thickened blood vessels. In these fibrous areas are found groups of large mononuclear cells, lymphocytes, multinucleated giant cells, eosinophiles, and histiocytes.

Final Pathological Diagnosis.—Hodgkin's disease of the left lung with nodular involvement of the right lung, liver, and jejunum; generalized involvement of the lymph nodes and vertebral marrow; indurative atelectasis, and fibrosis of the left lung, with bronchiectasis and cavitation; fibrosis of the left pleura and acute fibrinous pericarditis.

DISCUSSION

Evidence that Hodgkin's disease may reveal itself most prominently in organs other than the lymph nodes, the associated lymph node enlargements assuming a secondary rôle, has been presented by Symmers (6). Versé (7), in a review of the lesions of the lungs in Hodgkin's disease, noted pulmonary involvement in 29 out of 73 cases. Predominant pulmonary involvement in Hodgkin's disease has been frequently reported (2, 3, 7, and 8), but convincing proof of the pulmonary origin of the disease exists in only three instances. In Altmann's (9) case the process was limited to the bronchi and lungs. Weber (10) reported a case with exclusive pulmonary involvement, and another in which only the lungs and hilar nodes presented the lesions of Hodgkin's disease. In the other reports, although the initial clinical evidence of the disease was pulmonary, and the lungs remained predominantly involved, conclusive evidence of the pulmonary origin is lacking when generalized Hodgkin's disease is disclosed at necropsy.

Although it is similarly impossible to establish with certainty the primary nature of the pulmonary involvement in the case herein reported, the limitation of the clinical phenomenon to the left lung for a period of five years offers suggestive evidence of the pulmonary origin of the disease. Our experience with this case illustrates the confusion which may arise and lead to a diagnosis of lung tumor or pulmonary tuberculosis, when involvement of lymph nodes, spleen, or liver is absent. The dramatic response to roentgen therapy furnishes valuable evidence in the differential diagnosis.

BIBLIOGRAPHY

(1) WESSLER, H., and GREENE, C. M.: Intrathoracic Hodgkin's Disease: Its Roentgen Diagnosis. Jour. Am. Med. Assn., Feb. 14, 1920, **74,** 445.

(2) MOOLTEN, S. E.: Hodgkin's Disease of Lung. Am. Jour. Cancer, June, 1934, **21,** 253–294.

(3) FALCONER, E. H., and LEONARD, M. E.: Hodgkin's Disease of Lung. Am. Jour. Med. Sci., June, 1936, **191,** 780–788.

(4) PEIRCE, C. B., JACOX, H. W., and HILDRETH, R. C.: Roentgenologic Considerations of Lymphoblastoma. Am. Jour. Roentgenol. and Rad. Ther., August, 1936, **36,** 145–164.

(5) RUBENFELD, S.: Undiagnosed Lung Tumor: Response to Irradiation. RADIOLOGY, November, 1934, **23,** 627–629.

(6) SYMMERS, D.: The Clinical Significance of the Pathological Changes in Hodgkin's Disease. Am. Jour. Med. Sci., February, 1924, **167,** 157, and March, 1924, **167,** 313.

(7) VERSÉ, M.: Die Lymphogranulomatose der Lunge und des Brustfells. Handbuch der speziellen pathologischen Anatomie und Histologie. F. Henke and O. Lubarsch. Julius Springer, Berlin, 1931, **3,** 280.

(8) WACHNER, G.: Über die Lymphogranulomatose der Lungen. Fortschr. a. d. Geb. d. Röntgenstrahlen, June, 1934, **49,** 620–631.

(9) ALTMANN: Vereinigung der Pathologischen Anatomen Wiens. Wien. klin. Wchnschr., 1927, **40(2),** 957.

(10) WEBER, HERBERT: Lungenlymphogranulome. Beitr. z. path. Anat. u. z. allg. Path., Feb. 14, 1930, **84,** 1–32.

MULTIPLE DIVERTICULA OF THE FIRST PART OF THE DUODENUM

By FRANZ J. LUST, M.D., *New York City*

Diverticula of the intestinal tract are well known, those of the colon being encountered most frequently. However, diverticula of the duodenum are comparatively rare. During our careful analysis of the literature we did not find even a single case with more than two diverticula arising from the first part of the duodenum; we assume, therefore, that our findings may prove to be of some interest.

Case Report.—K. S., male, aged 56 years, had vague complaints and discomfort in the right upper quadrant of the abdomen for about fifteen years. He suffered from mild heartburn and gas eructation. Occasionally, he experienced a slight feeling of pressure in the epigastrium. His appetite was good. His bowels moved normally. He never had acute pains or cramps. His weight had been stationary for the past few years. He had no nausea or vomiting.

The patient was well nourished; heart and lungs normal; blood pressure 140/80; abdomen soft; liver and spleen showed no sign of enlargement, no definite tenderness on palpation. On very hard pressure on the right side of the epigastrium he complained of slight discomfort. Stomach contents after alcohol test meal showed slight amount of mucus, free HCl 18, total HCl 32. The stomach contents showed no blood. Examination of the stools, following a meat-free diet of three days, showed no evidence of occult blood. The blood count was normal.

X-ray Examination.—Esophagus normal. Stomach filled without delay, in hook form. The lower pole of the larger curvature situated in the interspinous line. The mucosal pattern of the stomach normal. Curvatures normal. Peristalsis increased. The pylorus opened immediately after the peristalsis reached it. The cap was filled readily. From the top of the cap, three small ducts leading into three diverticula, were visualized. The x-ray plates in the upright position showed these diverticula with horizontal fluid level and gas bubbles on top. The second portion of the duodenum was situated behind the antrum; the other part of the duodenum was normal and free from the presence of diverticula. The best view of the diverticula was furnished by the left oblique position. After two hours, a slight residue was observed in the stomach. The diverticula had not emptied, and the remainder of the barium was in the small intestines. After six hours the stomach was empty, and the diverticula were well filled, showing the same grape-like aspect. The remaining barium was in the ileo-cecal portion of the intestines. After 24 hours, the diverticula were empty, and there was only a filling of the colon. The treatment of the patient was limited to diet and alkali. The patient's condition improved to a certain extent, but all the complaints were not eliminated. An operation was suggested, but it met with the patient's opposition. A control examination six months later showed findings analogous to those already reported.

Fig. 1. Radiograph taken in upright position showing the multiple diverticula of the duodenum.

Our case presents, as all the other cases of duodenal diverticula, no special syndrome. The patient's complaints are similar to those characterizing chronic ulcer cases, the only existing difference being that the discomfort lasts longer after meals.

These findings suggest the possibility of congenital diverticula to which three types, namely—diverticula in the first, second, and third parts of the duodenum—possibly belong. However, we have no definite proof for the cause or origin of diverticula. Most of them have hitherto been reported in advanced age, so that an opinion generally prevails that they are caused by deficient structure and by weakness of the intestinal wall. This theory was advanced with the first discovery of diverticula

in the colon of patients with constipation of long standing. But this theory cannot be applied to diverticula found in the duodenum and in the small intestines presenting no evidence of stasis. Such deformities are probably due to some congenital factor; their continued enlargement, on the other hand, may be due only to stasis of food in the diverticula. The theory of congenital origin can be borne out by data concerning diverticula in the small and large intestines.

The treatment of these cases is of necessity the same as of those with pyloric syndrome. Surgical intervention, however, must take place when the administration of internal medication fails to alleviate the patient's condition.

Summary.—A case with multiple diverticula originating in the first portion of the duodenum is reported, and the rarity of such diverticula is discussed.

17 E. 89th St.

A SIMPLE COMPRESSOR

By M. J. GEYMAN, M.D., *Santa Barbara, California*

We are impressed with the number of imposing and elaborate mechanisms now offered by manufacturers for compression and "spot film" technic. There seems to be a general belief among members of the roentgenological profession that an expensive contrivance is necessary to produce "spot films" and pressure studies of gastro-intestinal structures. This is far from true. It is our feeling that many roentgenologists are denying themselves the use of a valuable supplementary procedure because they think the expenditure for new equipment is too great.

Our interest in compression technic was stimulated by the early publications of Akerlund, in which he showed some magnificent films made by a rotating grid mechanism in combination with a bakelite pressure cone. Thinking that all that was necessary to dupli-

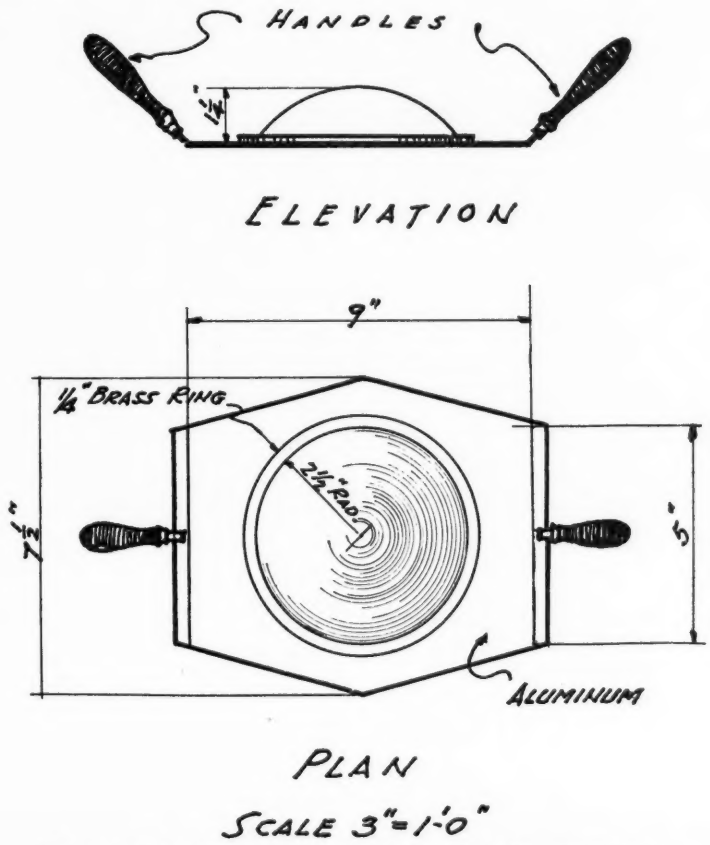


Fig. 1. Sketch showing dimensions and shape of a simple compressor.

cate his beautiful work was similar equipment, we immediately acquired one of these very clever devices. While the grid was mechanically ingenious, when it was used with the pressure cone the results left much to be desired, even though we had made necessary changes to permit energization of the fluoroscopic tube with sufficient current to permit short exposures. We were forced to discard the grid mechanism and resort to the use of a simple compression medium. Together with various pads and cones, we used a Chaoul compressor, which was more generally satisfactory than our "home made" efforts, but it could not be kept in place, either with the belt provided or with the help of the patient's hands. We, therefore, designed a compressor which is a modification of an aluminum hemisphere used by Rigler after his period of study in Sweden.

Fig. 2. The simple compressor described, showing it as held by the patient.

Our compressor consists of a strip of aluminum fashioned into a shallow cone. Handles are attached to the flanged sides, and a thin steel ring placed around the margins of the dome. The ring provides an opaque circle for centering the pressure dome under the fluoroscopic screen (Fig. 1). After the usual fluoroscopic study of the stomach and cap with the small barium meal, the pressure device is held by the patient, being centered over the desired area (Fig. 2). The degree of pressure best adapted to relief study is determined and necessary energy changes made to permit short exposures. The cassette is held against the flat side of the compressor and the exposure is made (Fig. 3). On one of our units, after the device is centered, an assistant steps to the control booth and makes the desired setting. It is not absolutely essential that a rapid changing energy control be available to the examiner's hand, as with very little coaching most patients co-operate readily. With each exposure the image of the barium-coated duodenal cap or stomach is flashed on the screen, the examiner obtaining a fairly good idea of what the film will show. The smallest possible area of exposure is used. When the diaphragm is cut down to a screen image of 5×5 in. or less the lead-gloved hands of the examiner holding two diagonal corners of an 8×10 cassette, are safely out of the harmful radiation zone, as shown by measurements by H. J. Ullmann in our routine work. A measurement of our fluoroscopic setting gave 13 r.m., chamber at table top in center of beam (reading corrected for pressure and temperature). The same chamber (25 r) at the outside edge of the beam on the anterior of the patient's abdomen for one minute gave too little ionization to be read on the scale. Four radiographic exposures with the chamber at the back of the compressor placed on the patient's abdomen also registered too little to be read.

We use the erect position almost exclusively for compression study of the stomach and cap, and have no fears as to the danger of too much pressure in this position, but we do feel there is some danger in prone compression as greater degrees of pressure are necessary for good relief patterns.

Fig. 3. Cassette against compressor (ordinarily behind fluoroscopic screen).

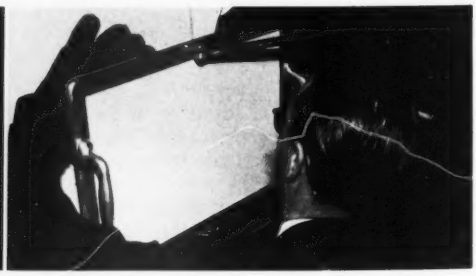


Fig. 4. Cassette being held for exposure.

CONCLUSIONS

A simple type of compressor is described which, in the hands of an experienced roentgenologist, will produce the same quality of relief studies of the duodenal bulb and portions of the stomach as can be obtained with more elaborate and expensive compression mechanisms. The following factors are essential to produce good compression studies.

1. The examiner must be an experienced fluoroscopist.

2. Sufficient energy must be available to the fluoroscopic tube to permit short exposures. Most films should be obtained between 0.1 and 0.25 second; more than 0.4 sec. is undesirable and over 0.5 sec. unsatisfactory.

3. Some form of compression device, preferably simple, is desirable, particularly until the examiner is proficient in this supplementary phase of gastro-intestinal study. The compressor described above is made for us by our local hardware dealer, at a cost of three dollars. If expense is no item, the more elaborate devices sold with some of the better combination tables are desirable to have, since they do facilitate the procedure. For details of interpretation and use of compression technic one should read the excellent publications of the original contributors in the European literature and later communications in our own journals.

RADIOLOGICAL SOCIETIES IN THE UNITED STATES

CALENDAR

MEETINGS FALLING BETWEEN THE DATES OF MAY 15 AND JUNE 30

May 18–20. Illinois State Society, Section of Radiology, Peoria, 87th annual meeting.

May 19. Connecticut State Medical Society, Section on Radiology, Hartford.

May 21–22. Pennsylvania Radiological Society, Erie, annual meeting.

Editor's note.—Will secretaries of societies please co-operate with the Editor by supplying him with information for this page.

CALIFORNIA

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. Meets annually with California Medical Association.

LOS ANGELES COUNTY MEDICAL ASSOCIATION, RADIOLOGICAL SECTION. *President*, D. R. McColl, M.D.; *Vice-president*, John F. Chapman, M.D.; *Secretary*, E. N. Liljedahl, M.D.; *Treasurer*, Henry Snure, M.D. Meets every second Wednesday of month at County Society Building.

PACIFIC ROENTGEN CLUB. *Chairman*, Raymond G. Taylor, M.D., 1212 Shatto St., Los Angeles; *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco.

COLORADO

DENVER RADIOLOGICAL CLUB. *President*, W. Walter Wasson, M.D., 246 Metropolitan Bldg., *Vice-president*, Ernst A. Schmidt, M.D., Colorado General Hospital; *Secretary*, Nathan B. Newcomer, M.D., 306 Republic Bldg.; *Treasurer*, Leonard G. Crosby, M.D., 366 Metropolitan Bldg. Meets third Tuesday of each month at home of some member. Midsummer Conference, Shirley-Savoy Hotel, July 15–17.

CONNECTICUT

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Chairman*, R. H. Lockhart, M.D., 144 Golden Hill St., Bridgeport; *Secretary-treasurer*, Max Climan, M.D., 242 Trumbull St., Hartford. Meeting, May 19, Hartford.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

FLORIDA

FLORIDA STATE RADIOLOGICAL SOCIETY. *President*, Gerald Raap, M.D., 168 S. E. First St., Miami; *Vice-president*, H. O. Brown, M.D., 404 First Nat'l Bank Bldg., Tampa; *Secretary-treasurer*, H. B. McEuen, M.D., 126 W. Adams St., Jacksonville.

ILLINOIS

CHICAGO ROENTGEN SOCIETY. *President*, David S. Beilin, M.D., 411 Garfield Ave.; *Vice-president*, Chester J. Challenger, M.D., 3117 Logan Blvd.; *Secretary-treasurer*, Roe J. Maier, M.D., 7752 Halsted St. Meets second Thursday of each month, September to May, except December.

ILLINOIS RADIOLOGICAL SOCIETY. *President*, Ivan Brouse, M.D., 316 W. State, Jacksonville; *Vice-president*, Cesar Gianturco, M. D., Carle Hospital Clinic, Urbana; *Secretary-treasurer*, Edmund P. Halley, M.D., 968 Citizens Bldg., Decatur. Meetings quarterly by announcement.

ILLINOIS STATE SOCIETY, SECTION OF RADIOLOGY. *President*, Roswell T. Pettit, M.D., 728 Columbus St., Ottawa; *Secretary*, Ralph G. Willy, M.D., 1138 N. Leavitt St., Chicago. Eighty-seventh annual meeting at Peoria, May 18–20.

INDIANA

INDIANA ROENTGEN SOCIETY. *President*, E. M. Van Buskirk, M.D., 347 W. Berry St., Fort Wayne; *President-elect*, J. N. Collins, M.D., 23 E. Ohio St., Indianapolis; *Vice-president*, H. H. Inlow, M.D., 3 W. Washington St., Shelbyville; *Secretary-treasurer*, C. C. Taylor, M.D., 23 Ohio St., Indianapolis. Meeting May 9, at Indianapolis Athletic Club.

MAINE

See New England Roentgen Ray Society.

MARYLAND

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, H. E. Wright, M.D., 101 W. Read St., Baltimore. Meetings each Monday night.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

DETROIT X-RAY AND RADIUM SOCIETY. *President*, C. C. Birkelo, M.D., Herman Keifer Hospital; *Vice-president*, E. W. Hall, M.D., 10 Peterboro St.; *Secretary-treasurer*, E. R. Witwer, M.D., Harper Hospital. Meetings first Thursday of each month from October

to May, inclusive, at Wayne County Medical Society Bldg.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *President,* J. C. Kenning, M.D., 1536 David Whitney Bldg., Detroit; *Vice-president,* A. W. Chase, M.D., 133 Toledo St., Adrian; *Secretary-treasurer,* C. S. Davenport, M.D., 609 Carey St., Lansing.

MINNESOTA

MINNESOTA RADIOLOGICAL SOCIETY. *President,* J. Richards Aurelius, M.D., 1210 Lowry Medical Arts Bldg., St. Paul; *Vice-president,* Walter H. Ude, M.D., 78 S. 9th St., Minneapolis; *Secretary,* Leo G. Rigler, M.D., University Hospitals, Minneapolis. Meetings quarterly.

NEBRASKA

NEBRASKA STATE RADIOLOGICAL SOCIETY. *President,* Howard B. Hunt, M.D., 4740 Hickory St., Omaha; *Secretary,* D. Arnold Dowell, M.D., 117 S. 17th St., Omaha. Meetings first Wednesday of each month at 7 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.) *President,* A. E. O'Connell, M.D., 390 Main St., Worcester, Mass.; *Secretary,* E. C. Vogt, M.D., 300 Longwood Ave., Boston. Meetings third Friday of each month from October to May, inclusive, usually at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

NEW JERSEY STATE RADIOLOGICAL SOCIETY. *President,* W. W. Maver, M.D., 532 Bergen Ave., Jersey City; *Vice-president,* J. D. Tidaback, M.D., 382 Springfield, Summit; *Secretary,* P. S. Avery, M.D., Middlesex General Hospital, New Brunswick. Meetings at Atlantic City at time of State Medical Society, and Midwinter in Newark as called by President.

NORTH CAROLINA

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *President,* Robert J. Reeves, M.D., Duke Hospital, Durham; *Secretary-treasurer,* Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings in May and October.

OHIO

RADIOLOGICAL SOCIETY OF THE ACADEMY OF MEDICINE (Cincinnati Roentgenologists). *President,* Harold G. Reineke, M.D., Cincinnati General Hospital, Cincinnati; *Secretary-treasurer,* George Benzing, M.D., St. Elizabeth's Hospital, Covington, Ky. Meetings third Tuesday of each month.

PENNSYLVANIA

PENNSYLVANIA RADIOLOGICAL SOCIETY. *President,* W. E. Reiley, M.D., Clearfield; *First Vice-president,* Charles S. Caldwell, M.D., 520 S. Aiken Ave., Pittsburgh; *Second Vice-president,* Louis A. Milkman, M.D., Medical Arts Bldg., Scranton; *Secretary-treasurer,* Lloyd E. Wurster, M.D., 416 Pine St., Williamsport; *President-elect,* S. J. Hawley, M.D., Danville. Annual meeting, May 21–22, Erie.

PHILADELPHIA ROENTGEN RAY SOCIETY. *President,* Thomas P. Loughery, M.D., Germantown Hospital; *Vice-president,* Elwood E. Downs, M.D., Jeanes Hospital, Fox Chase; *Secretary,* Barton H. Young, M.D., Temple University Hospital; *Treasurer,* R. Manges Smith, M.D., Jefferson Hospital. Meeting first Thursday of each month from October to May, Thompson Hall, College of Physicians, 19 S. 22nd St., 815 P.M.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

SOUTH CAROLINA X-RAY SOCIETY. *President,* Robert B. Taft, M.D., 105 Rutledge Ave., Charleston; *Secretary-treasurer,* Hillyer Rudisill, M.D., Roper Hospital, Charleston. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

MEMPHIS ROENTGEN CLUB. Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

TENNESSEE STATE RADIOLOGICAL SOCIETY. *President,* John L. Hankins, M.D., 300 Boone St., Johnson City; *Secretary,* F. B. Bogart, M. D., 546 McCallie Ave., Chattanooga. Meeting annually with State Med. Soc. in April.

VERMONT

See New England Roentgen Ray Society.

WASHINGTON

WASHINGTON STATE RADIOLOGICAL SOCIETY. *President,* H. E. Nichols, M.D.; *Secretary,* T. T. Dawson, M.D., Meetings fourth Monday of each month at College Club., Seattle.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

THE ROENTGENOLOGIC ASPECT OF CANCER OF THE PANCREAS

It is now appreciated that nearly all of the abdominal viscera lend themselves to roentgenologic diagnosis, most of them by the use of some radiopaque substance or substances. The accuracy with which lesions of the gastrointestinal tract are now being diagnosed with the roentgen ray is fully recognized. Diseases of the gall bladder are readily recognized when that organ is visualized by an opaque dye. The size and shape of the liver and spleen—and often tumors of these organs—have been visualized by the intravenous injection of thorium dioxide, and at times by the introduction of air into the abdominal cavity, certain organs are brought into relief so that a complete study can be made. The roentgen diagnosis of diseases of the genito-urinary tract visualized by opaque medium is a daily procedure. Even the abdominal lymphatics have been visualized with thorium dioxide.

The pancreas remains as one of the few abdominal organs which has not as yet been made to absorb radiopaque substances, and for this reason, it cannot be visualized for direct roentgenologic study. This important organ plays a vital rôle in the maintenance of health, and when diseased, serious consequences often ensue. While we appreciate that cancer of any abdominal organ is serious, the fact that with the roentgen ray disease often may be recognized early, offers some hope for the patient. In the instance of the pancreas, this is not true, as when cancer of the pancreas is recognized it is usually well advanced, due to our inability to visualize the organ.

We have to resort to indirect signs, such as pressure and encroachment on neighboring viscera, for the demonstration of tumor of this organ. In many instances this method of examination is inaccurate and misleading. This should stimulate us to a further study of this organ, with the hope that some means will be found by which it can be studied roentgenologically with greater accuracy.

The literature on the subject reveals some interesting observations made from time to time by earnest workers, using the roentgen ray in their studies. Only a few are mentioned here.

In 1923, Dickson (1) described certain deformity produced on a stomach and duodenum filled with bariumized fluid, which might have been due to cancer of the pancreas. Some time later, Butler and Ritvo (2) called attention to a displacement, with a widening of the duodenal curve as a result of the pressure of a tumor of the head of the pancreas. Rigler (3), in an interesting study, confirmed Butler and Ritvo's observations, namely, that it was possible in a large number of cases of cancer of the pancreas that the duodenal curve was enlarged. But he also observed that in cases in which the neoplasm affected the body and tail of this organ, the stomach was displaced upward and forward, while the transverse colon was displaced downward.

Engel and Lysholm (4), in 1934, described their method of studying the pancreas by distending the stomach with gas, and making lateral films of the patient's abdomen in the prone position. In this manner they were able to demonstrate an enlarged pancreas by the increase in the space which it occupied, and at times a tumor of this organ was seen in relief when its shadow protruded on the gas shadow of the stomach.

In 1935 Borak (5) made use of cholecystography in studying tumor of the pancreas. He observed that in cases wherein the common duct was completely occluded, there was no filling of the gall bladder and no stasis of dye in the colon. But in the early stages, before the common duct had become completely occluded, he observed that the gall bladder was enlarged and also that the shadow produced by the dye remained over a long period of time.

Recently, Paul (6) reported 23 cases of carcinoma of the pancreas, the majority of which gave some evidence of the presence of

the neoplasm when studied by means of a barium meal. In a certain number of cases the roentgen ray could not be relied upon for a diagnosis.

It is evident from a study of the observations made by many investigators in the diagnosis of cancer of the pancreas, that much remains for us to learn. It would appear that at the present time, while the roentgen ray is of value in certain instances in the diagnosis of cancer of the pancreas, reliance should not be placed entirely on this method, but a clinical examination by a competent internist or surgeon should be obtained, in consultation with the roentgen findings, if we hope for earlier diagnosis.

BIBLIOGRAPHY

(1) DICKSON, W. H.: Diagnosis of Obscure Abdominal lesions by the Roentgen Gastro-intestinal Examination. Am. Jour. Roentgenol. and Rad. Ther., 1923, **10,** 540.

(2) BUTLER, P. F., and RITVO, M.: Extra-bowel Pathology. Am. Jour. Roentgenol. and Rad. Ther., 1931, **24,** 474.

(3) RIGLER, L. G.: Diagnosis of Extra-gastro-intestinal Abdominal Masses. RADIOLOGY, 1933, **21,** 229.

(4) ENGEL, A., and LYSHOLM, E.: A New Roentgenological Method of Pancreas Examination and its Practical Results. Acta Radiol., 1934, **15,** 635.

(5) BORAK, J.: Die Cholecystographie als Untersuchungsmethode bei Pankreastumoren. Wien. klin. Wchnschr., March 29, 1935, **48,** 399.

(6) PAUL, L. W.: Roentgen Diagnosis of Carcinoma of the Pancreas. Am. Jour. Cancer, December, 1936, **28,** 720.

COMMUNICATION

EXPLANATION OF CHARTS

RECOMMENDED BY THE STANDARDIZATION COMMITTEE OF THE RADIOLOGICAL SOCIETY OF NORTH AMERICA, INC., 1937

The Standardization Committee of the Radiological Society of North America has designed a chart or form for recording roentgen treatments as illustrated. The explanation of these charts has been published in pamphlet form and can be obtained with orders for the charts from D. S. Childs, M.D., Secretary-Treasurer of the Radiological Society of North America, 607 Medical Arts Bldg., Syracuse, New York. Questions which may arise in regard to the correct usage of the forms may be directed to U. V. Portmann, M.D., Cleveland Clinic, Cleveland, Ohio, or any other member of the Standardization Committee.

1. The Standardization Committee of the Radiological Society of North America deems it advisable to recommend a standard form or chart for recording the factors used in administering treatments with roentgen rays. The general acceptance and usage of this standard form should encourage accuracy in planning treatments and create mutual understanding about the procedures employed by different individuals, thus ensuring uniformity in recording the technical factors, especially in publications when technics are described. After almost two years of study, the Committee has designed a chart form which should be acceptable. It contains all essential data about treatment factors in proper order and convenient spacing.

2. Two forms have been designed to be printed on the standard $8^1/_2 \times 11$ inch page usually used for institutional records and in private offices. The page may be folded in half so that the record will be $4^1/_4 \times 5^1/_2$ inches to conform to another standard size sometimes preferred. The forms will be obtainable separately or printed together on opposite sides of one sheet of paper or card in a variety of colors. The printed matter may be centered on the page or offset to allow sufficient margin at the left, right, top or bottom for binding or for printing additional data, the names of the institutions or individuals, etc. Thus, these forms can be adapted to almost any sort of record or filing system.

3. Form No. 1 was designed for those who prefer to keep clinical data and the record of treatments on one sheet or card in which case Form No. 2 would be printed on the opposite side of Form No. 1. It may not be necessary to use Form No. 1 in institutions or offices where clinical data are kept in detail or where other accepted record systems are used but it should be a convenient form for private practitioners. The headings for the horizontal lines on Form No. 1 are self-explanatory. It should be noted that provision has been made for recording measurements of the body and disease regions which necessarily must be made when the plans for treating a patient are outlined, in order to pre-determine the quantity of radiation to be administered to different regions. The bottom half of the page is left blank for drawing, stamping, or printing anatomical diagrams. It is suggested that rubber stamp anatomical outlines will be useful for this purpose. They may be obtained through the American Medical Association at reasonable prices, in many varieties and sizes which illustrate different regions of the body. The portals of entry or fields of radia-

tion and the disease regions can be sketched in these outlines quite easily and accurately.

4. Form No. 2 should be used by all radiologists to comply with the recommendations of the Standardization Committee. This form provides spaces for recording all essential physical data and their use in giving treatments. When this form is used alone, there will be sufficient space at the top or margin in which to have printed any headings desired in addition to lines for the name of the patient, number, and diagnosis. The back of the page may be used for anatomical diagrams, for recording measurements of the body and disease regions, or other data which may be desired.

STANDARD CHART FOR ROENTGEN THERAPY

NAME: NO.
ADDRESS:
DIAGNOSIS:
PREVIOUS TREATMENT:
CLINICAL NOTES:
DISEASE, LOCATION, EXTENT, PATHOLOGY:
DISEASE MEASUREMENTS:
BODY MEASUREMENTS:
PLANS FOR TREATMENT:

Fig. 1. Reduced from actual size.

5. On Form No. 2 the "Calibrated Physical Factors" of technic are arranged in one group and the data concerning their application to the patient in another group under the heading, "Daily Record of Treatment." This arrangement obviates the necessity of writing each day those physical factors which are not changed during the course of treatment of a patient. Usually a radiologist will employ several technics for the treatment of different types of diseases. The differences between technics depend largely upon variations in voltages and filters, or more than one apparatus may be used. A physicist who is registered by the Standardization Committee should standardize and calibrate each apparatus for every technic that the radiologist uses. A permanent record of these calibrations should be kept for ready reference in book form or charts. For convenience, each different technic or set of physical factors should be given individual identification by designation with a letter or number. When the radiologist has decided which technic he will employ in the treatment of a patient whose record is being compiled, he will write its letter or number designation and all of the "Calibrated Physical Factors" which pertain to it in the appropriate spaces provided on the form as will be explained.

6. Under the heading, "Calibrated Physical Factors," the first column is headed "Tech" (technic). In the first space below should be written the letter or number chosen to designate the technic which will be employed in the treatment of the patient, and the physical factors

which apply to this technic will be written along the first horizontal line in the proper spaces. When this is done, there will be no necessity for rewriting these factors each day that a treatment is given. It might happen that two or even three different technics would be used in treating a patient. To meet this contingency, three horizontal lines have been provided. If a second or third technic is used, the letter or number designating each should be written in the "tech" column, and the physical factors which apply to each of them should also be written along the horizontal lines in the proper spaces.

CALIBRATED PHYSICAL FACTORS

TECH	DESCRIPTION OF APPARATUS	kv	FILTRATION			hvl	ma	BEAM SIZE	DIST. cm	r/m AIR	
			INHERENT	ADDED	TOTAL	mm					

DAILY RECORD OF TREATMENT

DAY	DATE	TECH	REGION TREATED	FIELD SIZE	fsd cm	min	r AIR	QUANTITY ON SKIN					QUANTITY ON DISEASE				
								r/m	FIELD r	EXIT r	TOTAL r		%	r/m	DAY r	TOTAL r	

Fig. 2. Reduced from actual size.

7. "Description of Apparatus": Under this heading a brief description of the apparatus should be given, including especially the type of current used—whether pulsating or constant potential—and also the type of tube—whether air-suspended or oil-immersed.

8. The physical factors which have to do with the quality of the radiation are grouped together as headings for the next columns between heavy vertical lines.

9. "kv." (kilovolts): In choosing a technic it is natural first to decide upon the voltage which will be used. Voltage should be designated as "Peak" or "Constant" according to the type of apparatus used.

10. "Filtration": Filtration naturally follows kv. as a factor influencing quality. Under this heading are columns and spaces for recording the thickness in millimeters of all filters which may be used for the technic employed.

11. "Inherent": Under this heading should be written the copper equivalent thickness of any filtration which is inherent in the tube or tube holder. This applies especially to metal or oil-immersed tubes.

12. "Added": The thickness of any filter which is added to any inherent filter should be written in this column. When large ionization chambers are used in the beam of radiation, the copper equivalent thickness should be included as a part of the "Added" filtration.

13. "Total": This column is provided to summarize the total amount of filtration which should be expressed in millimeters of the metals used for the technic.

14. "hvl. mm.": According to international agreement, the quality of a roentgen-ray beam should be expressed by half value layers in millimeter thicknesses of aluminum for low voltages and in copper for high voltage. The correct designation of the quality should be written by appropriate abbreviations in the spaces of this column.

15. The physical factors which have to do with the quantity of radiation are grouped together as headings for the next columns between heavy vertical lines.

16. "ma." is used to indicate the milliamperage used for the technic.

17. "Beam Size": Under this heading is noted the linear size in cm. of the beam through a diaphragm or cone used in making the calibrations for the technic. This size may vary during the treatment; therefore in the "Daily Record of Treatment" provision has been made under a heading "Field Size" for indicating any change. Due allowance and corrections should be made for changes in the size of the beam. See paragraph 26.

18. "Dist. cm." (distance in centimeters from tube focus to ionization chamber): This distance may be varied in giving the treatment; therefore, in the "Daily Record of Treatment" provision has been made for indicating any change under a heading "fsd cm." Due allowance and correction should be made for changes in distance according to the inverse square law. See paragraph 27.

19. "r/m air" (roentgens per minute in air): This is the output in roentgens per minute of an apparatus according to the calibrated physical factors used for the technic.

20. A column has been left blank in which to write other data. The Standardization Committee suggest that the "roentgen value" for the technic be recorded in this column. This factor is determined under the following standard conditions: A standard distance of 100 cm. shall be used from the tube focus to a standardized thimble ionization chamber placed in the center of a beam which is delineated by a 10 x 10 cm. diaphragm placed 20 cm. above the chamber (or 80 cm. from the tube focus). Under these standard conditions, the r/m measured in air (back-scattering excluded) gives the "roentgen value" for the other technical factors used.

21. Under the heading "Daily Record of Treatment" are columns, lines, and spaces for recording the data concerning the application of the technic used throughout the course of treatment.

22. "Day": This column is provided for recording the sequence of days or the order in which different regions of the body and fields may be irradiated. The total number of days over which the course of treatment extends will be indicated.

23. "Date": This column is used for recording the date on which any treatment is given. It is suggested that the year number be written immediately under "date" at the head of the column and the month and day numbers in the spaces below.

24. "Tech" (Technic): In this column should be written the letter or number designation of the technic used on the day a treatment is given. It refers to the technic described above under the heading "Calibrated Physical Factors." Example: A theoretical case of a patient with an epithelioma of the lip. The radiologist decides that first he will treat the lesion with a technic which he has chosen to designate by the letter "A," and later to treat the cervical gland-bearing area by another technic which he has designated "C." He will have written in the description of the physical factors for each of these technics under the heading "Calibrated Physical Factors" as previously explained. Then on the days that "A" technic is used, he will write that letter in the "Tech" column in the "Daily Record of Treatment" and likewise he will write "C" in this column on the day he uses this other technic. This obviates the necessity for rewriting the full details of each technic daily.

25. "Region Treated": The region of the body treated may be indicated by appropriate descriptive names, abbreviations, initials, or numbers as preferred and should refer to anatomical diagrams which have been made showing the fields and disease regions treated, as previously suggested.

26. "Field Size": The size of the field irradiated should be given in linear dimensions in cm. of the area on the skin which is irradiated and should not be expressed in square cm. The size of the field may differ from the beam size used in making the calibrations for the technic and therefore the r/m air also will be different. Consequently, due allowance and corrections should be made for changes in the quantity (r/m air) which will result. Note: When oil-immersed tubes are used, it will be necessary to make direct and individual measurements for each change in field dimensions from the "beam size" used in calibrations because of the scattering from the oil in the container.

27. "fsd cm." (Tube focus, skin distance): The focus-skin distance used in treatment may differ from that used in making the calibrations for the technic and therefore the r/m air also will be different. When the distance is varied, due allowance and corrections should be made for the changes in quantity (r/m air) which will result according to the inverse square law. Note: When oil-immersed tubes are used, the inverse square law cannot be applied; therefore it will be necessary to make direct and individual measurements for each change in distance from that distance used in calibrations because of the amount of back-scattering from the oil in the container.

28 "min.": (minutes of treatment) represents the number of minutes used for the treatment in order to give the predetermined quantity on the skin.

29. "r air": (roentgens in air) indicates the number of roentgens in air that will be given in the period of time (minutes) over which the treatment is given according to the physical factors for the technic employed and after corrections have been made for any changes in the size of the field or distance.

30. Under the group heading "Quantity on the Skin" are columns for recording the quantity of radiation in roentgens which affects the skin according to the technical factors used. All the calibrations or calculations of quantity which have been made previously have been

based upon measurements made in air. When a treatment is given according to the conditions which have been recorded, a certain amount of back-scattering will affect the skin and this must be taken into consideration. The Standardization Committee is fully aware that the roentgen may not be a true measure for tissue effects according to strict physical criteria and the definition of this unit; however, in practice it is very convenient and satisfactory to express and think of tissue dosage in roentgens. Therefore, in designing this chart, provision has been made for recording in roentgens the quantity of radiation which affects the tissues including direct and back-scattered radiation. It is the practice of some radiologists to measure the quantity on the skin, including direct and back-scattered radiation with standardized thimble ionization chambers placed on the skin in the field and others estimate it on the basis of charts or curves which show the percentage of back-scattering according to the quantity of direct radiation under the technical conditions used for the treatment.

31. "r/m" (roentgens per minute on the skin): This is to express the rate at which the skin is affected. It is the practice of some radiologists to measure this factor directly by placing the thimble chamber of a dosimeter in the skin in the field of radiation and others estimate it on the basis of the roentgens per minute in air with correction for the amount of back-scattering. Example: If the treatment time is 20 minutes to give 200 r air and it is estimated that there is 40 per cent back-scattering, the r/m skin will be calculated as follows: (200 r + 40% of 200 r) ÷ 20 min. = r/m skin. 200 r + 80 r = 280 ÷ 20 = 14 r/m on skin.

32. "Field r" (Field roentgens on the skin): This is the total number of roentgens which affect the skin during the treatment. It is the practice of some radiologists to measure this factor directly by placing the thimble chamber of a dosimeter in the skin in the field of radiation and others estimate it on the basis of the roentgens per minute in air with correction for the amount of back-scattering. Example: According to the physical factors of the technic, 200 r air are to be given and, after taking into consideration the field size and volume of tissue, it may be estimated that there is 40 per cent back-scattering. Then the "Field r" will be 200 r + 40% of 200 r = 280 r.

33. "Exit r" (Exit roentgens on the skin): This column shows the amount of radiation in roentgens that affects an area on the skin of the side of the body opposite to that being treated. This quantity must be taken into consideration when this opposite area is to be used as a field in the course of treatment and must be added to the amount which is received subsequently. The exit r usually has been estimated from isodose charts, curves, or tables which show depth absorption measurements that are applicable to the technical conditions used for the treatment. While such methods do not give accurate values for the exit dose, they give a reasonable approximation which may be used in practice until better information is available. Example: A pelvis is to be treated through the suprapubic and sacral fields which are 20 × 20 cm. square and the pelvis is 20 cm. in the anterior-posterior diameter. The suprapubic field is to be given 250 r on the first day. Under the technical conditions employed, the absorption curves might show that 15 per cent of the amount on the surface reached a depth of 20 cm. Therefore, from the suprapubic field, the sacral field would receive 15 per cent of 250 r or 37.5 as the "exit r." In recording the "exit r" the number should be written on the horizontal line used to record the data concerning the region of the body to which it applies. Thus, in this example, it was the sacral field which received the "exit r" and the amount which it received should be recorded on the horizontal line which will apply to the sacral area. The suprapubic field will not receive exit radiation until the sacral field is treated, then the "field r" and "exit r" in each area will be added together to give the "total r" as will be explained.

34. "Total r" (Total roentgens on the skin): The total quantity of radiation in roentgens which affects the skin of any field will be the "field r" (including direct and back-scattered radiation) plus any "exit r" which it may receive from another field. Example: As in the previous example, a suprapubic area is given 250 r on the first day and this number will be recorded in both the "field r" and "total r" columns because this area has not yet received any "exit r." However, the sacral field receives 37.5 (15% of 250 r) from the suprapubic field and therefore 37.5 exit r will be recorded on the horizontal line which will apply to the data concerning the sacral field when it is treated. On the second day the sacral field also is given 250 field r. Therefore, the "total r" which the sacral area will have received will be 37.5 r + 250 r = 287.5 r on this second day.

The opposite suprapubic field also will have received the same amount on the second day.

35. A blank column has been provided in which to record other data about the quantity on the skin which may be desired. In designing those forms, no provision has been made for indicating *per diem* tissue losses or for keeping a record according to "saturation" technics. Those who prefer to keep their records according to this plan may use this blank column for recording the estimated percentage *per diem* losses or may keep any other charts which they prefer in addition to this standard form.

36. The objects of recording the quantity on the skin according to this plan are (1) to insure taking into account all of the radiation which any area receives, (2) to be able at any time to ascertain the amount that any area has received to date, and (3) to be able to determine without any other calculations when a pre-determined or skin tolerance quantity has been given. These objectives are reached quite easily by summing up from time to time the total amount which already has been given or by keeping a running total of the amount of radiation which has been given to each field at preceding treatments in the "total r" column. There are two methods for keeping the running totals.

First method: As each field is treated, the record is kept in the sequence in which treatment is given and the amount which has been administered previously is added to that given on the day of treatment. By keeping this running total for each field from day to day, there is no necessity for adding the total r at another time because the amount already given on each area will be indicated at all times and when the predetermined quantity or skin tolerance is reached the treatment may be discontinued.

The second method: When planning the course of treatment for the patient, the radiologist decides how many fields he will use and the amount which he expects to give on each. Then he may allow a certain number of horizontal lines in sequence for each field and either keep a running total or add the "total r" for each field from time to time until the pre-determined amount is reached.

37. The heading, "Quantity on disease" gives a record of the amount of radiation that is applied in the disease tissues.

38. "%" (per cent): This is the percentage of the surface radiation that reaches the center of the disease region as estimated on the basis of absorption isodose curves, charts, or tables. Example: It may be found that 50 per cent of the surface dose reaches to the depth of the center of a disease region. The number 50 will be written in the "%" column.

39. "r/m": (roentgens per minute) shows the rate in roentgens at which the disease is treated and is comparable to the "r/m" rate on the skin. Example: If 10 r/m might be given on the skin and 50 per cent reached the depth of a disease area, then (50 per cent of 10) 5.0 r/m would be the rate on the disease. There are indications that in the future it may be desirable to treat different types of disease at different rates, and therefore records should be kept which will be desirable for reference in this regard.

40. "Day r": (Day roentgens) is the estimated quantity of radiation in roentgens that the center of the disease region receives on the day of treatment. This is comparable to the "field r" in the "quantity on skin" heading. The number of roentgens is estimated according to the percentage of the skin dose which reaches the depth of the disease. Example: If 250 roentgens are given on a skin field and 50 per cent reaches the disease, the "daily r" to this area will be 125 roentgens.

41. "Total r": (total roentgens) shows the total quantity of radiation in roentgens which reaches the center of a disease region through all the portals which may be used. This may be recorded as a running total in the same manner as the "total r" on the skin was recorded. Example: If on the first day of treatment, 250 roentgens are given on the skin and the disease area receives 50 per cent of this or 125 roentgens as recorded in the "Daily r" column, then on the second day the same treatment and amounts are given through another portal, the disease region will have received a "total r" of (125 r + 125) or 250 r. In this manner it is easy to record the estimates of how much radiation was applied to a particular disease region. From clinical observations of the results obtained, conclusions may be reached about the efficacy of this amount of treatment and what quantity of radiation is necessary to eliminate different types of disease.

42. Blank columns are provided to be ruled and headed according to the wishes of the radiologist, for names or initials of radiologists, or technicians or for other data.

The standard order forms may be obtained from: D. S. Childs, M.D., Secretary-Treasurer, Radiological Society of North America, 607 Medical Arts Bldg., Syracuse, New York.

IN MEMORIAM

JAMES JOHN QUINEY
1881–1937

James John Quiney, M.D., of Easton, Pa., died at his home March 31, after a short illness. He gave up general practice in 1922 to specialize in roentgenology and radium therapy. Dr. Quiney, who was a member of the Radiological Society of North America, was past president of the Pennsylvania Radiological Society and of the Philadelphia Roentgen Ray Society. Professionally he was also affiliated with the Lehigh Valley Medical Society, Pennsylvania State Medical Society, American Medical Association, Philadelphia College of Physicians, American Roentgen Ray Society, was a fellow of the American College of Radiology, and president of the Northampton County Medical Society. He attended Jefferson Medical College at Philadelphia.

BOOK REVIEWS

AMERICAN MARTYRS TO SCIENCE THROUGH THE ROENTGEN RAY. By PERCY BROWN, M.D., F.A.C.P., F.A.C.R., Historian and former President of the American Roentgen Ray Society. A volume of 276 pages. Published by Charles C. Thomas, Springfield, Illinois. Price, $3.50.

That the roentgen rays took a heavy toll of suffering and death among the first American workers with this amazing form of energy is well known, but few persons, including many present-day radiologists, fully realize how long is the roll of sacrificial pioneers or how significant were their accomplishments. Yet not less than twenty-eight of those who blazed the path for roentgenologic advance in this country paid for their devotion with their lives and left behind as an enduring monument the facts they won so dearly, the fundamental truths that we of to-day accept so casually.

The roll: Dally, Ascheim, Weigel, Fuchs, Egelhoff, the brothers Wagner, Kassabian, Thomas, Early, Leonard, Baker, Green, Bauer, Dodd, Glidden, Caldwell, Morehouse, Robarts, Sims, Machlett, Swett, Morrison, Baetjer, Pitkin, Satterlee, Kraus, and Parker. A majority were physicians, some were electrical engineers, technicians, or artisans. All added something, great or small, to roentgenologic science and art. All still live in the recollection of older radiologists, and even to younger practitioners many of the names will have a familiar sound.

Of each, Percy Brown has told the story—an interesting and different story of the contributions that each one made—a pathetic and similar story at the end. Every radiologist who has the slightest interest in the history of his profession should have the book.

DIAGNOSTIC ROENTGENOLOGY. Edited by ROSS GOLDEN, M.D., Professor of Radiology, the College of Physicians and Surgeons, Columbia University; Director of the Department of Radiology, Presbyterian Hospital, New York. A volume of 854 pages (loose leaf). Published by Thomas Nelson and Sons, New York, 1936. Price, $20.00.

American text-books relating to roentgenologic diagnosis have been limited chiefly to monographs concerning special subjects and to short concise books written primarily for students. Because of the great advances in roentgenology and its close relation to all the branches of medicine the subject has become too formidable for any one man to attempt to write a comprehensive treatise of the subject. Dr. Golden has solved this problem in a most practical manner by compiling a loose leaf system of diagnostic roentgenology in which the various chapters, which can be revised as time demands, are written by various authors who have acquired a reputation for special work in the field concerned.

The first edition of this loose leaf system consists of eleven chapters which cover the most important fields of roentgen diagnosis. They are as follows:

Diseases of the Skull and Intracranial Contents	C. G. Dyke
Examination of the Nasal Sinuses and Mastoids	G. W. Grier
The Chest	C. B. Rabin
Digestive Tract	R. Golden
Diseases of Bone	P. C. Hodges, D. B. Phemister, A. Brunschwig
Spinal Cord Tumors	C. G. Dyke
Urinary Tract	L. Jaches, M. L. Sussman
Uterotubography	S. A. Robins, A. A. Shapira
Obstetrics	H. C. Moloy, P. C. Swenson
Fractures	E. H. Skinner

All of the chapters are extensively illustrated

and present the fundamental diagnostic criteria for that particular subject, some more completely than others. As a whole this volume represents the most comprehensive consideration of the subject of roentgenologic diagnosis that has yet appeared in the English language. The book is obviously written primarily for the general practitioner, student, and less experienced radiologist, and for this group it should have a great appeal. Even the experienced radiologist can learn much from this book but those who are interested in a thorough and comprehensive consideration of any particular subject will still find it necessary to refer to special monographs and the more inclusive foreign texts. Undoubtedly subsequent revisions and additional chapters will greatly enhance the value of this highly commendable addition to the roentgenologic literature.

GEFÄSSMISSBILDUNGEN UND GEFÄSSGESCHWULSTE DES GEHIRNS (Congenital Vascular Anomalies and Vascular Diseases of the Brain). By PROF. DR. H. BERGSTRAND, Direktor des Instituts für Allgemeine Pathologie und Pathologische Anatomie des Karolinischen Instituts in Stockholm; PROF. DR. H. OLIVECRONA, Direktor der Neurochirurgischen Klinik in Stockholm, and PROF. DR. WILHELM TÖNNIS, Leiter der Neurochirurgischen Abteilung des Staatlichen Luitpoldkrankenhauses in Würzburg. A volume of 181 pages, 137 illustrations. Published by Georg Thieme, Leipzig, Germany, 1936. Price, bound, 26 R.M.

This comprehensive and detailed consideration of congenital anomalies and diseases of the vascular system of the brain is written by three authors, each of whom is well known for his contributions to this subject. The text is arranged in seven chapters. The first chapter by Tönnis is a short introduction, Chapter II by Bergstrand concerns the pathologic anatomy of hemangiomas of the central nervous system. The following conditions are discussed together with case histories, photographs of gross specimens, drawings and roentgenograms: angioma cavernosum, angioma racemosum (five varieties), angioretikulomas, angioblastomas, Lindau tumors and angiogliomas. In Chapter III Olivecrona presents a review and classification of the clinical material. Chapter IV by Olivecrona relates to Sturge-Weber's disease which is thoroughly discussed by means of case histories, operative findings, roentgenograms, and arteriograms. Tönnis in Chapter V discusses in detail arterio-venous aneurysms and presents numerous interesting arteriograms. Chapter VI, also by Tönnis, relates to racemose venous angiomas. In Chapter VII Olivecrona discusses the pathologic anatomy, incidence, symptomatology, diagnosis, and treatment of angioretikulomas.

This outstanding text will be of interest to all neurologists, neurosurgeons, and neuroroentgenologists. To the roentgenologist it will illustrate in a very excellent manner the great value of intracranial arteriography in revealing the character and extent of vascular lesions of the brain.

TRAITE DE CHIRURGIE ORTHOPEDIQUE. (Volume I, in five volumes). By L. OMBREDANNE, Professeur de clinique chirurgicale infantile et orthopedie à la Faculte de medecine de Paris, membre de l'Academie de medecine, chirurgien de l'hôpital des Enfants-Malades, and P. MATHIEU, Professeur de clinique de chirurgie orthopedique de l'adulte à la Faculte de medecine de Paris, chirurgien de l'hôpital Cochin. A volume 902 pages, 433 illustrations. Published by Masson et Cie, Paris, 1937. Price, 300 fr.

This is the first volume of a five-volume work edited under the supervision of these authors, both of whom are outstanding surgeons. The scope of the work is exhaustive, covering almost every known phase of orthopedic work. In the General Table of material in Volumes I to V, given in this volume, the outline shows that the subject has been taken up in anatomical sequence, as follows:

Part I. Physiology, pathology, and general therapeutics; Part II. Spine and superior extremity; Part III. Pelvis and inferior extremity; Part IV. General technic.

Volume I, with which this review is concerned, covers congenital malformations, affections of the bones, affections of the joints, surgical operations of bones and joints, affections of the muscles, tendons and aponeuroses, and affections of the skin.

A glance through the list of collaborators shows that they have all been selected from the leaders of orthopedic surgery in France. For this reason the work is strongly French in its scope and character and may be said to represent the up-to-date views of orthopedic surgery as seen in France to-day. We do not mean to imply that the viewpoint of other countries has

not been given—most of the important works from other countries are duly mentioned and emphasized. The bibliographies, however, are not as complete as some would like to see in a work of this size and scope.

The work is well arranged and the style excellent. The reproductions of photographs and x-rays are excellent. In the section on "Osteosynthesis" several types of internal fixation, not commonly used in the United States, are illustrated and described. The elaboration of this type of fixation has become so great that one must hesitate to accept all of the various types recommended if for no other reason than that they complicate rather than simplify the treatment of fractures.

In general, the subject matter covers all the various ramifications of orthopedics and as a general review of the subject it is obviously well done. The subject of orthopedic surgery has developed so much that many phases of surgery, which a few years ago would have no place in orthopedics, are to-day recognized as parts of orthopedic surgery in many parts of the world. From this standpoint the work is well conceived. Almost every phase of surgery in which an orthopedist can be interested is touched on.

With the publication of the other volumes many points briefly touched on in this volume may be elaborated, at least we hope so. We are sure of the need of such a complete presentation of the subject as is here undertaken. It will be a useful reference system in any surgeon's library, whether or not he is devoting his time entirely to orthopedics.

ROENTGENOLOGY—THE BORDERLANDS OF THE NORMAL AND EARLY PATHOLOGICAL IN THE SKIAGRAM. By ALBAN KÖHLER, Prof. Dr. Medizin, Wiesbaden. Second revised English edition. Translated and edited by ARTHUR TURNBULL, M.A., B.Sc., M.B., Ch.B., Ex-demonstrator of Anatomy, University of Glasgow. A volume of 681 pages, 400 illustrations. Published by William Wood & Company, Baltimore, Maryland, 1935. Price, $14.00.

This is the second English edition of a unique text-book of roentgenologic diagnosis, which in previous editions achieved probably more international popularity than any other book concerning the subject. The basic parts of the text are founded on the thirty-odd years' personal experience and observations of Professor Köhler. That section of the book relating to the osseous system makes up nearly one-half of the volume and reflects the author's deep interest in roentgenology of the skeletal system, for which he is best known. This part in itself will ren in as a fitting monument to a keen observer and a wise teacher.

Succeeding editions of this work have grown in size, not so much by contributions from the original author as by the addition of much heterogeneous material from the literature, largely of European and British origin, that is intended to widen the appeal of the text. In its present form the book suffers greatly from the effects of careless or injudicious editing since no attempt has been made to delete former statements and references to work that has long since been disproved by subsequent observations. The inclusion of such information is dangerous for students and quite misleading to those who are inclined to believe much of what they read, especially in a well-known volume of this type. No consistent system has been followed in the format of the bibliography and many important and informative American references have been omitted. In the growth from one edition to another the author's original purpose has been lost sight of and the present volume takes on more the make-up of a text-book of general diagnosis rather than a presentation of the borderlands of the normal and early pathological as originally intended.

It is hoped that this book will soon be entirely revised and re-edited in the light of our present knowledge so it may again become a safe and informative reference for students, practitioners, and radiologists.

DAS VENTRIKULOGRAM. BY ERIK LYSHOLM, Dozent für Medizin Radiologie, and BERTIL EBENIUS and HANS SAHLSTEDT, Assistenten am Röntgeninstitut, Seraphimerkrankenhauses, Stockholm. Part. I—RÖNTGENTECHNIK. Supp. XXIV, Acta Radiologica, 74 pages, with 74 illustrations. Published by P. A. Norstedt & Sons, Stockholm, Sweden, 1935. Price: 10 Sw. cr. ($2.80), paper cover.

This is the first of a series of monographs concerning ventriculography that are being prepared by Dr. Lysholm and his associates in the Röntgeninstitut of the Seraphimerkrankenhauses in Stockholm. Dr. Lysholm is well known in Europe for his contributions to

neuroroentgenology and the ingenious devices that he has developed for a more efficient roentgenologic examination of the skull.

The first part of the monograph is devoted to a consideration of the anatomy of the intracranial cerebrospinal spaces, a knowledge of which is fundamental to an intelligent interpretation of ventriculograms. The second chapter, written by Sahlstedt, concerns the normal ventriculogram and is illustrated by numerous ventriculograms and drawings. The third chapter, by Ebenius, concerns the principle of the interpretation of ventriculograms. The fourth chapter is a comprehensive description of the technic of ventriculography by means of Lysholm's skull apparatus. Each of the authors' standard positions are illustrated by photographs of the patient and the corresponding roentgenogram. The structures revealed by each position are enumerated. The concluding chapter concerns the technic of examination for ventriculography with iodized oil; here also photographs of the patient in various positions and the corresponding roentgenograms are shown.

This concise presentation of the technic of ventriculography is the most valuable and informative consideration of the subject that has yet appeared. It is indispensable to anyone who is interested in performing ventriculography efficiently and interpreting the results intelligently. The text is short and concise and those who do not read German will find an English translation to be a worthwhile investment.

DAS VENTRIKULOGRAM. By ERIK LYSHOLM, Dozent für Medizin Radiologie, and BERTIL EBENIUS and HANS SAHLSTEDT, Assistenten am Röntgeninstitut, Seraphimerkrankenhauses, Stockholm. Part III.—THIRD AND FOURTH VENTRICLES. Supplement XXVI, Acta Radiologica, 124 pages. Published by P. A. Norstedt & Sons, Stockholm, Sweden, 1935. Price: 12 Sw. cr. ($3.36), paper cover.

This is the third of a series of monographs concerning ventriculography that have been prepared by Dr. Lysholm and his associates in the Röntgeninstitut of the Seraphimerkrankenhauses in Stockholm. Those who are fortunate enough to possess the first part of this series of monographs will readily appreciate the wealth of information that is contained in this volume. The authors have subdivided the lesions affecting the third and fourth ventricles into eleven groups according to their anatomical location. These are enumerated as follows:

1. Anterior part of the third ventricle and foramen Monro.
2. Posterior part of the third ventricle.
3. Quadrigeminal area.
4. Aqueduct (stenosing ependymitis).
5. Pontine area.
6. Cerebello-pontine angle.
7. Roof of the fourth ventricle and vermis.
8. Cerebellar hemispheres.
9. Body of the fourth ventricle and medulla oblongata.
10. Fourth ventricle (intraventricular tumors).
11. Subarachnoid space of the posterior fossa (arachnoiditis).

The ventriculographic characteristics for each group are enumerated and the diagnostic signs are illustrated by typical roentgenograms and tracings. The conclusions are based on a large group of cases which have been studied with the meticulous technic for which Dr. Lysholm and his associates are well known.

This small concise monograph contains more practical information concerning the ventriculographic findings in lesions affecting the third and fourth ventricles than can be gained by a review of all the literature concerning the subject. Like the preceding volumes in this series, the text is in German; however, it is not long and a translation should not be difficult.

ABSTRACTS OF CURRENT LITERATURE

CONTENTS BY SUBJECT

Abscess, Pulmonary 639
Apparatus 639
Bone Diseases (Diagnosis) 639
Breast Cancer 640
Bursitis 640
Cancer (Diagnosis) 640
Cancer (Therapy) 640
Dosage 641
Endarteritis Obliterans 641
The Eye 641
The Foot 641
Foreign Bodies 642
Gall Bladder (Normal and Pathologic) 642
Gastro-intestinal Tract (Diagnosis) 642
Gastroscopy 644
Gynecology and Obstetrics 644
Heart and Vascular System 644
The Hip Joint 645
Hodgkin's Disease 646
Inflammatory Diseases 646
The Larynx 646
The Lungs 647
Physiotherapy 648
The Pituitary Body 648
Pneumothorax 649
The Prostate 649
Pruritus Vulvæ 649
Radium 650
Roentgen Kymography 650
The Stomach 650

THE FOLLOWING ABSTRACTORS HAVE CONTRIBUTED TO THIS ISSUE

J. N. Ané, M.D., of New Orleans, La.
S. M. Atkins, M.D., of Waterbury, Conn.
George E. Burch, Jr., M.D., of New Orleans, La.
J. E. Habbe, M.D., of Milwaukee, Wis.
E. T. Leddy, M.D., of Rochester, Minn.
E. A. Pohle, M.D., Ph.D., of Madison, Wis.
E. M. Shebesta, M.D., of Detroit, Mich.
William A. Sodeman, M.D., of New Orleans, La.
William R. Stecher, M.D., of Easton, Pa.
Charles G. Sutherland, M.B. (Tor.), of Rochester, Minn.

CONTENTS OF ABSTRACTS IN THIS ISSUE LISTED ALPHABETICALLY BY AUTHORS

Aretz, H. Experiences with Radium Therapy of Hemangioma 650
Atakam, Serif, *with* Magnus-Alsleben, E., jt. auth. 639
Barker, Paul S., *with* Freyberg, R. H., jt. auth. 648
Bromley, J. F. Basophilic Hyperpituitarism .. 649
Busse, A. W. Genesis of Epithelioma by Kukirol 641
Coller, Frederick A., *with* Freyberg R. H. jt. auth. 648
Cottenot, P. Roentgen Therapy of Endarteritis Obliterans 641
Daniels, L. Polak. Therapeutic Artificial Pneumothorax in True Pneumonia 649
Dessauer, F. Theoretical Principles of Short Wave Therapy 648
Durusoy, Salâhi, *with* Magnus-Alsleben, E., jt. auth. 639
Elward, Joseph F. March Foot 642
Ettinger, A., *with* Schloss, J., jt. auth. 644
Fanconi, G. The Pseudo-syphilitic Subacute Hilar Bronchopneumonitis of the Undernourished Child 647
Fleckseder, R. Etiologic Factors of Bronchial Carcinoma 640
Fränkel, L. Osteomalacia 644
Freyberg, R. H., Barker, Paul S., Newburgh, L. H., and Coller, Frederick A. Pituitary Basophilism (Cushing's Syndrome): Report of a Verified Case, with a Discussion of Differential Diagnosis and Treatment 648
Friedl-Meyer, M. Casuistic Contribution Regarding Tumor-like Ulcerative Stenosing Inflammation of the Distal Ileum (Terminal Ileitis) 643
Fulton, J. Struthers. X-ray Therapy in Carcinoma of the Lung 647
Glanzmann, E. Osteogenesis Imperfecta (Vrolik Type) and Osteopsathyrosis Idiopathica. (Lobstein Type) 639
Glauner, R. Further Experiences with the Desensitization of Mucous Membrane during Protracted Fractional Roentgen Therapy ... 647
Gordonoff, T., and Ludwig, F. Vitamins in Cancer Therapy 640
Greineder, Kurt. Tomography and its Value in Lung Diagnosis 647
Gruninger, *with* Hansen, jt. auth. 642
Haberler, Gerhard. Early Treatment of Congenital Dislocation of the Hip Joint 645
Hansen and Gruninger. Broken Needle in Pericardial Sac of a One and One-half-year-old Child 642
Herman, Karl. Pericardial Calcification 644
Hindhede, M. Etiology of Carcinoma of the Stomach 650
Howitt, F. D., Pillman-Williams, E. C., and Russ, S. An Investigation of Internal Radon Therapy 650
Jenkinson, E. L. Cholecystography 642
Koch, W. Etiology of Prostatic Hypertrophy .. 649
Kottmann, K. Radiotherapeusis of Malignancy in Combination with a New Organic Iodine Compound 641
Kowarschik, J. The Present Status of Short Wave Therapy 648
Kreibig, W. X-radiation of the Blind Glaucomatous Eye 641
Lattman, Isidore. Treatment of Subacromial Bursitis by Roentgen Irradiation 640
Leucutia, T. Problems of Radiation Therapy with Ultra-high Potentials 641

LIEBESNY, P. Fundamental Principles and Therapeutic Results of Therapy with "Athermic" Short Waves 648
LONNE. Is There Any Practical Worth of the Klein Reaction in the Diagnosis of Cancer? .. 640
LUDWIG, F., *with* GORDONOFF, T. 640
MAGNUS-ALSLEBEN, E., DURUSOY, SALÂHI, and ATAKAM, SERIF. The Treatment of Pulmonary Abscess with Alcohol Injection 639
MATTI, HERMANN. Primary Mammary Carcinoma in the Axilla 640
MAYNEORD, W. V. Measurements on Soft Roentgen Rays (Chaoul Technic) 641
MERKELBACH, O. Filters for the Infra-red and Red Spectral Region 639
MITCHELL, JOSEPH I. Total Dislocation of the Astragalus 641
MOORE, SHERWOOD, *with* SCOTT, WENDELL G., jt. auth. 645
NEWBURGH, L. H., *with* FREYBURG, R. H., jt. auth. 648
O'BRIEN, F. W. Roentgen Treatment of the So-called Malignant Lymphomas 646
PASCHLAU, G. The Roentgen Examination as an Aid for Indication for Pylorotomy in Infants 643
PILLMAN-WILLAMS, E. C., *with* HOWITT, F. D., jt. auth. 650
PRATT, J. H., *with* SCHLOSS, J., jt. auth. 644
RAAB, W., *with* RECH, W., jt. auth. 646
RECH, W., and RAAB, W. Further Studies Regarding the Heating of Pelvic Organs with Short Wave Therapy 646
RUSS, S., *with* HOWITT, F. D., jt. auth. 650
SAVARESE, E. Primary Carcinoma of the Gall Bladder 642
SCHLIEPHAKE, E. Short Wave Therapy in Internal Medicine 648
SCHLOSS, J., ETTINGER, A., and PRATT, J. H. Diagnosis of Diseases of the Stomach 644
SCOTT, WENDELL G., and MOORE, SHERWOOD. Roentgen Kymography in Diseases of the Heart: A Relatively New and Efficient Aid in Diagnosis 645
SISTI, M. A., and SORICELLI, F. Roentgen Kymographic Examination of the Diaphragm Following Phrenico-exeresis 650
SORICELLI, F., *with* SISTI, M. A., jt. auth. 650
TIEMANN. Athlete's Lung 648
URBACH, C. The Present Status of Short Wave Therapy 648
WATT, W. L. Hodgkin's Disease and Deep X-ray Therapy 646
WEBSTER, J. H. DOUGLAS. Radical X-ray Treatment of Malignancy in the Larynx and Pharynx 646
WOBKER, WALTER. Roentgen Therapy of Pruritus Vulvæ 649

ABSCESS, PULMONARY

The Treatment of Pulmonary Abscess with Alcohol Injection. E. Magnus-Alsleben, Salâhi Durusoy, and Serif Atakam. Schweiz. med. Wchnschr., Dec. 12, 1936, **50,** 1262–1264.

Convincing reports and excellent roentgenograms are presented depicting the amazing resolution of typical pulmonary abscesses by the intravenous injection of alcohol (33 per cent—given every fourth day in amounts of 200 c.c.). In six cases, five were completely cured clinically and as shown anatomically on the roentgenograms. No untoward effects were noted. The working method of the alcohol in the pulmonic tissue is difficult to comprehend from a purely antiseptic standpoint; the most likely theory is the rapid oxidation therein, with production of acetaldehyde, which might act much like formaldehyde on tissue.

WILLIAM R. STECHER, M.D.

APPARATUS

Filters for the Infra-red and Red Spectral Region. O. Merkelbach. Strahlentherapie, 1936, **57,** 689.

The author studied and analyzed filters available for the infra-red and red spectrum. He classifies filters suitable for experimental work in this region and offers definite recommendations for their selection.

ERNST A. POHLE, M.D., Ph.D.

BONE DISEASES (DIAGNOSIS)

Osteogenesis Imperfecta (Vrolik Type) and Osteopsathyrosis Idiopathica (Lobstein Type). E. Glanzmann. Schweiz. med. Wchnschr., Nov. 14, 1936, **46,** 1122–1126.

Osteogenesis imperfecta (Vrolik's micromelia) commences in fetal life, after the seventh month. The new-born presents the following features: markedly foreshortened long bones, which are thickened and plump in appearance. There are generally concomitant multiple fractures which heal readily, and many showing abundant callus formation. The skull is enlarged, giving the impression of a small face. Palpation of the calvarium affords pathognomonic "gumball" impression, with isolated areas of firm osseous tissue. The fontanels and sutures are abnormally wide. The sclera are very blue in appearance due to transparent sclera and shining through of retinal pigment. The fingers of the outstretched arm do not reach the iliac crest, and the bowed lower extremities approximate an O-shape, which appearance is accentuated with incident equino-varus deformity. The prognosis is very poor, most cases being born dead. Occasionally a four-year survival occurs.

The roentgen findings are characteristic, showing diffuse cortical bone thinning, haziness of spongiosa structure, with intensified calcium deposition in the temporary zone of calcification of epiphyses. The ribs are widened and show bowed deformities, infraction, and healing. The entity is not hereditary. An interesting observation is the high thrombocyte count (500,000), together with slightly increased inorganic serum phosphorus content of the blood. There is assumedly insufficient osteoblast formation which accounts for the lack of normal ossification.

Osteopsathyrosis (Lobstein Type—fragilitas osseium).—These cases are apparently born normal, relative to skeletal proportions. The leading sign is the great tendency to fracture, even with the slightest trauma. The most frequent time of presentation of symptoms is from seven to 11 years of age. There are frequently subperiosteal fractures, but ample callus formation is likewise the rule. The bones are slender and gracile in appearance, often presenting bowing, which occurs near the mid-diaphyseal region rather than at a juxta-epiphyseal site as in rachitis. There is increased radiolucency of the osseous structure roentgenographically, with thinned diaphyseal compact bone, and relatively transparent epiphyses. The temporary zone of calcification is unaltered and the epiphyseal line is not widened. The skull strongly resembles the natiform caput as observed in osteogenesis imperfecta. The blue sclera is slightly different than the type that occurs in osteogenesis imperfecta, there being a violet hue. Of importance is the finding of progressive deafness, due to otosclerosis. The hair becomes thin and brittle, and there are deformed finger and toe nails. There is a thrombocytosis and slight eosinophilia, but no hemorrhagic diathesis is definable. There is slight lowering of the blood phosphorus content, much as in rachitis. The osteoblastic activity is similarly diminished and reduced. The prognosis is good, and after 20 years of age there is a definite remission of tendency toward fracture. The differential diagnosis between osteopsathyrosis and rickets is not difficult, as is that of scorbutus. Therapeutically, thyroid and parathyroid glandular extracts have been given, together with vitamins C and D.

The question whether these two types of Vrolik and Lobstein are merely forms of an identical disease is discussed. Many features in common are present in these two entities, and the supposition is that in the case of osteogenesis imperfecta the disease is so severe that it is incompatible with life whereas the Lobstein type is the *forme frustre.* The histopathology would seem to engender this theory of identical diseases wherein a dynamic dysfunction of the osteoblasts is present. The cardinal difference is the time of development, osteogenesis being a distinctly fetal disease. It is questionable and debatable whether or not mild forms of osteogenesis imperfecta later in life eventuate as osteopsathyrosis (Lobstein). The weight of opinion is against this supposition, which is further maintained by the lack of hereditary character of osteogenesis imperfecta in contradistinction to the very definite hereditary factor in osteopsathyrosis.

WILLIAM R. STECHER, M.D.

BREAST CANCER

Primary Mammary Carcinoma in the Axilla. Hermann Matti. Schweiz. med. Wchnschr., Nov. 21, 1936, **47,** 1159.

Ectopic mammary tissue or glands can occur anywhere along the "milk ridge," which extends from the axilla to the inguinal region; also, rarely in arm, shoulder, or back. A nipple may or may not be present, and tumefaction occurs synchronously with a normal physiologic process of other breasts. There is a much greater tendency for malignant change in ectopic mammary glands, and its early diagnosis is made difficult, mainly, by absence of pain, absence of indications of the possibility of mammary carcinoma, and suggestive findings of tuberculous lymphadenopathy. To further complicate matters a therapeutic test of irradiation is not diagnostic, as some degree of regression is noted in both instances. It is emphasized that coincident mastectomy of the adjoining seemingly normal breast is advisable, for rapid direct extension of the malignant process is the rule, and occurs early. It is not unusual for the process to remain latent for several years, with sudden activation and rapid spread to the lymphatic tissue, particularly about the vessels in the axilla.

WILLIAM R. STECHER, M.D.

BURSITIS

Treatment of Subacromial Bursitis by Roentgen Irradiation. Isidore Lattman. Am. Jour. Roentgenol. and Rad. Ther., July, 1936, **36,** 55–60.

Twenty cases of subacromial bursitis are presented in which roentgen therapy has been employed. The results justify the belief that roentgen therapy will relieve pain and restore function more rapidly than other methods of treatment. Many others were treated with equally good results, but were not followed from one to five years as were those reported.

One treatment of 350 r to the anterior or posterior shoulder with 200 kv., 0.25 Cu, 50 cm. distance, and field 15 × 15 cm. suffices, although at times, two treatments are required. The factors 140 kv., 5 ma., Al mm. 5, 15×15 cm. field, 16 cm. distance, 20 min., have also been employed. During the first 24 hours the symptoms may be aggravated, but within the next 24 hours improvement begins.

The etiology, pathology, anatomy, symptoms, differential diagnosis, and treatments are reviewed.

S. M. ATKINS, M.D.

CANCER (DIAGNOSIS)

Is There Any Practical Worth of the Klein Reaction in the Diagnosis of Cancer? Lonne. München. med. Wchnschr., Dec. 18, 1936, **51,** 2077, 2078.

In a survey of 69 cases, the test was correct in only 72.5 per cent, and the author concludes that to-day one must consider the clinical methods of examination far more important and reliable than serum diagnosis. He makes a plea for honest and sincere evaluation of any sero-diagnostic tests for malignancy, for only in this way will there be dispelled prejudice such as might accrue from unwarranted, over-enthusiastic claims which have been presented in the literature.

WILLIAM R. STECHER, M.D.

Etiologic Factors of Bronchial Carcinoma. R. Fleckseder. München. med. Wchnschr., Sept. 25, 1936, p. 1585.

A careful review of 63 cases of bronchial carcinoma has lead the author to the following deductions. In all cases there is a history of prior pulmonic and particularly bronchial damage or infection, and of the many cited causes pulmonary tuberculosis and involvement of the hilar and peribronchial lymph nodes causing bronchial pressure are mentioned as of greatest importance. Other factors, particularly atherosclerosis, syphilis, and chronic lead poisoning, associated with hypertension, are mentioned as causes. In females there is an additional endocrine factor, which manifests itself in the climacteric; however, the relatively few females presenting bronchial carcinoma lends weight to the argument that this disturbance acts indirectly in the form of vascular changes. There was a startling percentage of cases showing habits of excessive smoking, particularly of cigarettes, which could act dually in causing direct epithelial irritation and secondary vascular damage resultant from nicotine. The author concurs in the current concept of the actual increase in bronchial carcinoma.

The ratio of involvement of sexes was 6.75 to 1 in favor of males, and the greatest percentage occurred from 50 to 70 in the male, and from 45 to 55, in the female. The occupation of the patient is important and the high incidence noted in painters is attributable to chronic lead poisoning and vascular damage rather than bronchial irritation. A unique explanation for the increased percentage in waiters is their possible continuous exposure to tobacco smoke. Curiously in discussing the etiology in persons of healthy outdoor occupations, the possibility of frequent colds or pulmonary affections in this type of work is considered as predisposing. The site of involvement showed upper lobe origin two and one-half times as often as lower lobe and definitely a predilection for the right side.

WILLIAM R. STECHER, M.D.

CANCER (THERAPY)

Vitamins in Cancer Therapy. T. Gordonoff and F. Ludwig. Schweiz. med. Wchnschr., Nov. 14, 1936, **46,** 1129, 1130.

There is no foundation for the thought that vitamins would act as preventive or curative agents in

cancer, and the fostered example of the lessened incidence of malignancy in the southern climes is explainable on the basis of a shorter span of life rather than the effect of vitamins, etc. Experimental evidence has also proved this, in the case of inoperable malignancies in which this treatment was instituted, and in which no salubrious results were obtained for it is impossible to conduct such rigid dietary experiments as to make this method practical.

WILLIAM R. STECHER, M.D.

Radiotherapeusis of Malignancy in Combination with a New Organic Iodine Compound. K. Kottmann. Schweiz. med. Wchnschr., Nov. 14, 1936, **46,** 1145–1148.

A synergistic attempt of combined radiotherapy and a substance administered in the endeavor to increase the radiosensitivity of malignant cells is proffered. The preparation employed is iod-naphthol-disulfo acetate. The material is administered orally and intravenously. A case history is cited, in which hilar lymphogranuloma presented complete resolution with no evidence of recurrence over a period of one and one-half years. However, no biopsy or other indisputable proof was obtained, and incidentally, such remissions occasionally occur with roentgen therapy alone. Experimental work conducted upon mouse carcinoma and chondroma showed favorable results with combined therapy. A case of carcinoma solidum, involving the mediastinum, showed complete disappearance of compression signs and symptoms. Ordinarily this type of malignancy is very resistant to radiotherapy. The author stresses the fact that further observations upon a large group of cases must be made before the method can be properly evaluated.

WILLIAM R. STECHER, M.D.

DOSAGE

Measurements on Soft Roentgen Rays (Chaoul Technic). W. V. Mayneord. Strahlentherapie, 1936, **56,** 660.

The author presents the results of his thorough investigation of roentgen rays produced at 60 kv., to be used at a distance of from 3 to 5 cm. The findings are demonstrated in 11 graphs. A new type of dosimeter, used for these measurements, is described. Spectrographic and absorption studies showed that the radiation had an average wave length of 0.32 Å. The output corresponded to about 25 r per minute per ma. of tube current. Data are also given regarding backscatter, depth dose percentage and distribution of radiant energy in water.

ERNST A. POHLE M.D., Ph.D.

Problems of Radiation Therapy with Ultra-high Potentials. T. Leucutia Strahlentherapie, 1936, **56,** 633.

This is a brief discussion of some of the physical, biological, and clinical problems in x-ray therapy with potentials over 200 kilovolts. While it is too early at this time to predict the future development of this super-high voltage technic, the author is convinced that an increase of the potential to from 400 to 600 kv. or above will give better clinical results in certain cases. (See also Am. Jour. Roentgenol. and Rad. Ther., 1934, **31,** 628; also 1935, **34,** 664.)

ERNST A. POHLE, M.D., Ph.D.

ENDARTERITIS OBLITERANS

Roentgen Therapy of Endarteritis Obliterans. P. Cottenot. Strahlentherapie, 1936, **56,** 569.

The author saw good results in the treatment of endarteritis obliterans with roentgen rays. Exposure of the peripheral lesion as well as of the respective spinal ganglion seems to be effective. In both instances 200 r were given three times per week up to a total of from 1,000 to 1,200 r (130–140 kv., 5–8 mm. Al).

ERNST A. POHLE, M.D., Ph.D.

THE EYE

X-radiation of the Blind Glaucomatous Eye. W. Kreibig. Wien. klin. Wchnschr., July 3, 1936, pp. 843–845. (Reprinted by permission from the British Med. Jour., Oct. 10, 1936, p. 59 of Epitome of Current Medical Literature.)

The author favors, in all cases of painful eye with absolute glaucoma (of whatever causation), a trial of treatment by x-radiation—three small doses of 50 r every third day, with repetition, if necessary, at several intervals of one to two weeks. In a minority there is no response, and enucleation must be done. As a rule, however, there is disappearance of pain, which must be due to action on the sensory ocular nerves, for usually no reduction of tension follows. Irritative signs are not produced by this fractional therapy.

THE FOOT

Genesis of Epithelioma by Kukirol. A. W. Busse. München. med. Wchnschr., July 31, 1936, **31,** 1269.

A case of squamous-cell epithelioma of the dorsum of the toe is presented as a resultant from chronic irritation of medicament applied for relief of clavus.

WILLIAM R. STECHER, M.D.

Total Dislocation of the Astragalus. Joseph I. Mitchell. Jour. Bone and Joint Surg., January, 1936, **18,** 212–214.

The author reports a case of lateral and anterior dislocation of the astragalus. The dislocation was reduced under spinal anesthesia by closed manipulation. It was believed that the injury occurred when the patient's shoe heel caught on a step, as she slipped on the ice, thus causing her to fall down four steps.

J. N. ANÉ, M.D.

March Foot. Joseph F. Elward. Am. Jour. Roentgenol. and Rad. Ther., August, 1936, **36,** 188–193.

The author reviews the literature on the subject and also the various theories of causation and reports two additional cases, one which he classifies as of the acute type and designates "pied forcé," and the other of the chronic type properly called "pied surchargé." Differential diagnosis from sarcoma, Köhler's disease, and other pathologic and traumatic conditions is discussed.

J. E. Habbe, M.D.

FOREIGN BODIES

Broken Needle in Pericardial Sac of a One and One-half-year-old Child. Hansen and Gruninger. München. med. Wchnschr., Sept. 11, 1936, **37,** 1513, 1514.

A case is discussed which presented symptoms of mediastinal pressure, with generalized edema, dyspnea, ascites, hepatic and splenic enlargement, and marked albuminuria, due to a hemorrhagic exudative pericarditis, secondary to puncture by a broken needle. This was only suspicioned after roentgenographic examination. The site of entry was undetermined, but theoretically it was considered to be trans-dermal rather than per-oral. The needle was successfully removed under roentgenoscopic control.

William R. Stecher, M.D.

GALL BLADDER (NORMAL AND PATHOLOGIC)

Primary Carcinoma of the Gall Bladder. E. Savarese. Arch. Ital. di Chir., May, 1936, **43,** 297–313. (Reprinted by permission from British Med. Jour., Sept. 12, 1936, p. 40 of Epitome of Current Medical Literature.)

The author, who records illustrative cases in women aged from 32 to 60, maintains that primary carcinoma of the gall bladder is not so rare as is generally supposed. The condition is more frequent in women than in men in the proportion of 5 to 1. The average age at which it occurs is from 57 to 60, but cases have been recorded in young adults and even in childhood. All writers are agreed as to a close connection between a chronic inflammatory process and carcinoma of the gall bladder, the incidence of cholelithiasis ranging from 73 to 95 per cent in their cases. Macroscopically the tumor may assume a villous, an infiltrating, or a gelatinous form. Although it may be found in every part of the gall bladder, the site of election is the fundus. The tumor may invade the colon, stomach, duodenum, or liver. Histologically primary carcinoma of the gall bladder may be a cylindrical epithelioma or a diffuse carcinoma. The onset is insidious. Three stages may be distinguished, the first being characterized by pain and dyspepsia; the second by the appearance of the tumor and mechanical disturbances due to pressure caused by it, and the third by diffusion of the newgrowth. Jaundice is not a constant or early symptom, but is found in about 60 per cent of recorded cases. Early diagnosis is impossible. As a rule, the condition is discovered only at operation. Kirklin has reported 20 cases in which the tumor was discovered by radiographic examination, in four of which the diagnosis was confirmed by operation. The prognosis is always unfavorable. The duration of the disease varies from a year to a few months. Death usually occurs within six months of the appearance of jaundice. Treatment consists in removal of the gall bladder and the adjacent glands. The operation is attended with a heavy mortality (50 per cent), and there is little chance of a final recovery, death usually taking place within from one to five years.

Cholecystography. E. L. Jenkinson. Jour. Am. Med. Assn., Sept. 5, 1936, **107,** 755–757.

Cholecystographic examinations were made on 95 individual patients. Of these, 70 showed normal visualization. All the 95 patients had symptoms thought to be due to gall-bladder disease. Three patients failed to retain the dye for fifteen minutes and the lack of filling was not considered sufficient evidence to warrant a diagnosis of non-function. These patients refused further examination. All patients with non-filling gall bladders were examined again after a period of one month.

Fifty were to be placed on a normal diet as controls and 50 on a gall-bladder diet, rich in fats, with the addition of dehydrocholic acid three and three-quarters grains (0.25 gm.) three times a day with meals, when 100 non-filling gall bladders were obtained.

A patient with fairly typical gall-bladder syndrome following one negative gall-bladder response does not conclude the necessity for immediate operative intervention, as the patient will frequently show a normal cholecystographic response at a later examination.

The clinical course of many of these patients paralleled quite accurately the cholecystographic response; that is, taking a patient with symptoms attributed to gall-bladder disease, followed by a negative cholecystographic response, there was usually a marked improvement of the symptoms following medical management including dehydrocholic acid. Likewise, the cholecystographic response at this time was either improved or normal. These same patients who frequently showed an exacerbation of symptoms and were immediately subjected to cholecystographic examination usually showed a poorly functioning or a non-functioning gall bladder. A few patients showed no improvement after a rather prolonged medical regimen and likewise showed no improvement in the radiographic gall-bladder appearance.

Charles G. Sutherland, M.B. (Tor.).

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Casuistic Contribution Regarding Tumor-like Ulcerative Stenosing Inflammation of the Distal Ileum

(Terminal Ileitis). M. Friedl-Meyer. Schweiz. med. Wchnschr., May 23, 1936, **66**, 508–512.

A cursory review of the literature upon this subject is excellently presented. The lesion involves the ileo-cecal valve and usually 10 to 30 cm. of the contiguous distal ileum, but rarely is there extension into the cecum proper. Pathologically, the condition is a chronic enteritis with phlegmonous extension and marked proliferative reaction of the bowel walls, causing marked thickening and ensuing stenosis, comparable to a rigid rubber hose. Clinically this is manifest in symptoms of partial intestinal obstruction, as a rather late finding with palpable tumor formation. The early stages of inflammation are evidenced as rather strong simulation of an entero-colitis, with foul smelling stools with pus, blood, and mucous membrane casts; or subacute appendicitis. Perforation of the involved wall leads to fistulæ between bowel and cecum or sigmoid colon, or a walled-off abscess, with late abdominal penetration and resulting fecal fistula. It should be borne in mind that anemia and inordinate loss of weight are cardinal features and may suggest tuberculosis or malignancy.

Roentgenologically, the diagnosis is not difficult if borne in mind, for a barium meal shows delayed ileal transit with narrowing of the terminal ileum as manifest by the pathognomonic "cord or ribbon sign." If partial small intestinal obstruction exists, dilated small intestinal loops are readily noted. The cecum presents a filling defect due to the enormously thickened Bauhin valve. Opaque enema examination confirms cecal defect and absence of further colonic involvement plus ileo-cecal incompetency, which phenomenon is exceedingly valuable in outlining a stenosed terminal ileum. Both internal and external fistulæ can be shown, if present.

A differential diagnosis must be made of lymphopathia venereum (Frei test); tuberculosis; actinomycosis (cutaneous reaction); carcinoma, and bacillary or amebic dysentery. As to etiology, in over half the cases reported there had been a prior appendectomy, and rarely was there an active appendicitis present. There is the possibility of chronic lymphangitis of the regional mesentery causing elephantiasis of the involved gut, with superimposed secondary infection. The fact that there is such a marked anemia and anacidity suggests that these are primary factors with production of an enterogenous infection due to low resistance. Enterococci have been noted in stool but their significance is unknown. In no cases was there evidence of lymphopathia venereum.

Treatment consists of resection of the affected part if the patient is in physical condition to undergo an operation, and secondary enterocolonic anastomosis.

WILLIAM R. STECHER, M.D.

The Roentgen Examination as an Aid for Indication for Pylorotomy in Infants. G. Paschlau. München. med. Wchnschr., Dec. 4, 1936, **49**, 2007, 2008.

In 1930 a review of the literature from 1842 disclosed the astounding fact that there was an 18 per cent mortality in the treatment of pylorospasm in infants. In regard to the results of the Weber-Ramstedt operation for pyloric stenosis, the death rate was 25 per cent. However, this rather poor showing was not entirely resultant of the operation *per se*, but mainly due to the malnutritioned infant, who had been allowed to undergo marked wasting before operative intervention was instituted. It follows that betterment of statistics can be accomplished only by earlier surgical intervention in cases in which it is indicated, to be done only when a definite diagnosis is made. Unfortunately, the current practice appears to be relegation of cases to the surgeon only when marked and irremediable symptoms are present, *viz.*, marked vomiting, inordinate weight loss, etc. It is the practice of some physicians to procrastinate a definite interval of time, three days to two weeks, before seeking surgical help. This study was made to promulgate such certain definite indications for pylorotomy as could be accomplished by x-ray examination.

The accepted criterion for surgical intervention to date has been the presence of marked three-hour gastric retention. The author presents his own conclusions based upon experimental and clinical data. The roentgenologic technic of examination briefly is as follows: stomach is emptied in morning; two teaspoonfuls of barium is given, and infant is immediately roentgenoscoped to determine tonus, peristalsis, and emptying mechanism of stomach. At four and eight hours, respectively, control roentgenograms are obtained.

The author's deductions follow: 1. If there is four- and eight-hour complete retention in the stomach, an immediate operation is mandatory. 2. If at four hours there is less than one-fourth of the initial meal retained, or at eight hours less than one-half, an immediate operation is indicated. 3. If the gastric emptying function is good in the first four hours (more than one-fourth of contrast medium in intestines) and in the second four hours definite delay or absence of further emptying of stomach, then gastric atony is to be anticipated, which is a serious complication of pylorospasm, and the best procedure is immediate operative intervention. 4. If there is ejection of more than one-fourth of the contrast meal in the first four hours and one-half by eight hours, then there is a good prognosis for conservative medical management. If there be any doubt as to the degree of gastric retention, it is advised that operation be instituted. By following the above criteria the mortality in the author's series was reduced from 2 to 3.5 per cent. 5. In the case of Group 4, if with conservative handling the goal has not been reached in from 10 to 14 days, then operation is advised. If there be concurrent cardiospasm, that in itself is no contra-indication for pylorotomy, for this phenomenon has been observed to disappear immediately after pylorotomy. Also, gastric atony with concomitant gastritis is no contra-indication to surgery.

It is understood that certain clinical types of far advanced toxic constitution are extremely bad risks

for operation, and measures to bring the patient into condition in which there may be hope of surviving the ordeal of operation are to be employed. Succinctly, surgery should not be considered as the last resort but as an early procedure when indicated.

WILLIAM R. STECHER, M.D.

GASTROSCOPY

Diagnosis of Dieases of the Stomach by Gastroscopic and X-ray Relief Studies. J. Schloss, A. Ettinger, and J. H. Pratt. Am. Jour. Med. Sci., February, 1937, **193,** 171–180.

In the light of the great strides in the development and use of the gastroscopic and roentgenologic methods for the diagnosis and treatment of gastric diseases, the authors were prompted to report their observations on 100 cases in which both methods of study were employed. They briefly review the development of the gastroscope and x-ray methods of gastric study.

"The greater efficiency of modern x-ray visualization of the stomach is due to the application of four principles: (1) The use of a small amount of opaque medium in order to maintain some degree of transparency; (2) the application of graded compression in order to fill the depressions between the prominent structures of the mucous membrane; (3) fluoroscopy of the patient in various positions demonstrating the contours of the stomach in different planes; (4) small films snapped in selected positions during fluoroscopy, enabling the examiner to obtain permanent records of fleeting observations.

"Gastroscopy may be defined as the intravital inspection of the stomach mucosa by a non-operative procedure." The Wolf-Schindler gastroscope, as used to-day, consists of a semi-rigid upper portion and a semi-rigid lower portion, the latter portion containing a system of lenses of short focal distances. Its main advantage is that it demands less training than the use of the rigid type. Its greatest disadvantage is its 90° optic which requires that it be passed blindly through the esophagus, thus increasing the danger from perforation of the esophagus of cardia in cases in which an unexpected obstruction may exist. X-ray studies on esophagoscopy should precede the passage of the gastroscope in cases in which there is a possibility of such lesions.

The authors briefly describe the method of using the gastroscope.

The principles of both methods are summarized by stating that "we may say that the x-ray examination is a study of an elaborate plastic cast of the entire organ; gastroscopy gives an immediate, natural picture of circumscribed areas of the interior surface of the stomach which can be pieced together like a mosaic pattern."

The roentgenologic examinations inform us about shape, size, contour, tone, motility, peristalsis, position, emptying time, and gastric secretion of the stomach. They may reveal "large and medium-sized depths of the wall" and also reveal "comparatively coarse changes of the mucosa itself and of the mucosal folds."

"Gastroscopy on the other hand, may demonstrate even very fine changes and defects of the surface; it shows the folds in their natural appearance. It demonstrates the color of the mucous membrane, the distribution of blood, the filling of the blood vessels, hemorrhage, and so on. It may also give some impression as to tone, peristalsis, and gastric secretion. . . . . X-ray examination is superior where localized lesions, especially if not too small, are present; whereas generalized pathologic processes and very fine superficial changes are more the domain of the gastroscope. Therefore, the two methods are in no way in competition, but supplement each other successfully. The very lesions which x-ray examination fails to reveal can usually be visualized with the gastroscope, while those which can scarcely be seen by gastroscopy seldom cause difficulties for the roentgenologist."

The authors review and discuss their experiences with both methods in studying 100 consecutive cases in which both methods were used. From this study they concluded that, "For the diagnosis of gastritis, gastroscopy is by far superior to x-ray relief technic. Erosions and atrophy of the stomach mucosa can be diagnosed for all practical purposes by gastroscopy only.

"Gastric ulcers are more frequently encountered in gastroscopy than in x-ray. In cases of duodenal ulcers, almost always accompanying changes in the stomach are present.

"For the diagnosis of stomach tumors and of postoperative changes, x-ray relief method and gastroscopy supplement one another in an almost ideal way."

G. E. BURCH, M. D.

GYNECOLOGY AND OBSTETRICS

Osteomalacia. L. Fränkel. Schweiz. med. Wchnschr., Nov. 14, 1936, **46,** 1121, 1122.

The author discusses the various theories and types of osteomalacia, and is convinced of the endocrine relationship of inter-osteomalacia and ovariopriva (antagonists). The possibility of a pluriglandular effect rather than primary ovarian dysfunction etiology is to be considered; but nonetheless, there is empirical proof of the improvement of osteomalacia with the institution of castration, either surgical or radiologic. However, such radical procedures are not necessary since the desired result can be accomplished with antiovarian hormone together with dietary régime and vitamin D and sunlight.

WILLIAM R. STECHER, M.D.

HEART AND VASCULAR SYSTEM

Pericardial Calcification. Karl Herman. München. med. Wchnschr., May 29, 1936, **83,** 889–892.

This is not a rare or difficult diagnosis, and, combining clinical and roentgenologic studies, make it possible

in all cases. Clinically, one can summate the main findings as: long history of affection; pulse clear but distant, with absence of murmurs, and Wenckebach's sign of highest pulse after expiratory pause. It usually occurs in individuals of middle age. Characteristic of the condition are systolic retraction and diastolic heave of the anterior chest, with lagging of the lower portion of the sternum on deep inspiration. Of greatest importance is the disparity between functional and morphologic signs. Passive pulmonary congestion, with right heart failure, marked cervical venous congestion and pulsation, which is exceptionally marked in the recumbent posture, are almost always present. Hepatic enlargement and ascites are common.

Roentgenologically, the heart presents calcification along its border (most often along the left side), which can be observed roentgenoscopically on occasion. Heart excursions and motion on respiration are very limited, with cardiac apex fixed, even upon change of body position to the lateral recumbent posture. Frequently, pericardio-pleural synechiæ, causing tenting of the diaphragmatic dome, are observed. Diaphragmatic excursions are restricted along the mesial aspect, with elevation of the right cupola due to hepatic congestion. In inspiration heart and cupola (cardiophrenic angle) does not diverge or widen. The retrocardiac space is slightly encroached upon, due to right heart failure. An important study is a grid-diaphragm roentgenogram localized to the heart, which may well portray the calcification or add information relevant to other intra- or extra-cardiac calcification. Differential diagnosis must be made of: valvular or coronary calcification; aortic calcification; calcified echinococcic cysts; bronchial cyst, or other rare calcified tumors. Kymography lends valuable aid to localization and extent of concretio-pericardii, enabling effective surgical removal.

WILLIAM R. STECHER, M.D.

Roentgen Kymography in Diseases of the Heart: A Relatively New and Efficient Aid in Diagnosis. Wendell G. Scott and Sherwood Moore. Jour. Am. Med. Assn., Dec. 12, 1936, **107,** 1951–1954.

Roentgen kymography is a new and useful method recently developed for graphically recording the physiologic movements of an organ or structure on a single x-ray film. The basic principle was first conceived by the Polish physiologist, Sabat, in 1911, and independently by Gott and Rosenthal in 1912. Stumpf, of Munich, devised the multiple-slit grid and perfected the apparatus mechanically, so that by 1931 the method was practical, inexpensive, and of clinical value. The essential part is the grid, a large sheet of lead in which narrow horizontal slits are cut every 12 mm. apart. The opening in each slit is 0.4 mm. wide. The patient stands next to the grid and, during a continuous exposure of one and one-fourth second, the cassette slowly moves down behind the fixed grid a distance of slightly less than the space between two slits—actually 11 mm. Thus between every 11 mm. of exposed film there is 1 mm. of white, unexposed film, which divides the kymogram into frames. This method records simultaneously the movements of multiple points on the border of the heart or other structure roentgenographed. The points recorded are those small areas on the heart border which overlie a slit in the grid.

The size and shape of the heart are studied in the same manner as in the usual roentgenogram. The trough of a wave is that particular point at maximum systole, and the peak of the wave is the same point at maximum diastole. The lower leg of the wave is a record of the diastolic phase of the cardiac cycle, and the upper leg is a record of the systolic phase. The speed and amplitude of a movement alter the contour of the resulting waves, and these factors must be appreciated when analyzing kymograms. The time occurrence of movements in the different cardiac chambers and great vessels is determined by tracing side by side the waves in the various frames on a sheet of ruled paper. Each tracing is begun at the white line at the bottom of the frames. The time relationship of the movements is then established by drawing parallel lines, and all points on the same parallel line occur at the same instant.

Diagnostic kymographic tracings occur in aortic regurgitation, aortic stenosis, syphilitic aortitis, hyperthyroidism, myxedema, constrictive adhesive pericarditis, tuberculous pericarditis, pleuropericardial-diaphragmatic adhesions, aneurysms of the ascending aorta, cardiac infarction, "irritable" heart, and a few arrhythmias. These tracings also supply information concerning the tonicity of the heart muscle that is of prognostic importance. The authors were unable to recognize any consistent changes in the kymograms of patients with hypertension and arteriosclerotic heart disease.

CHARLES G. SUTHERLAND, M.B. (Tor.).

THE HIP JOINT

Early Treatment of Congenital Dislocation of the Hip Joint. Gerhard Haberler. München. med. Wchnschr., June 12, 1936, **83,** 967, 968.

The difficulty in treating this entity lies mainly in the difficulty of an early diagnosis which can be accomplished only by roentgenography. The predisposing cause of this condition is shallow acetabular cavity and poor shelving effect, the actual luxation occurring later in life. The author stresses the fact of our meager knowledge of the normal development of the hip joint, which is mandatory in deciding whether or not a suspicious case is luxated. To date, many mistakes have been made by clinician and radiologist, particularly in the degree of luxation estimate; for an improved luxation may remain outside the acetabular cavity, or, when actually good reduction has been accomplished, the distortion on the roentgenogram,

with the femur in abduction, may simulate continuance of the luxation. Diagnostic criteria for early diagnosis are enumerated: (1) roentgenographic demonstration of shallow acetabular cavity, with poor shelving, and cephalic and laterad displacement of femoral head; (2) when femoral head can be felt to be replaced clinically; (3) if, in attempting to replace luxation, shortening of adductors occurs, with associated marked resistance.

The author concludes that the earlier the treatment, the better the end-results; and the simpler the method of treating, varying from mere abduction with straddle pillows, or splints to plaster cast.

WILLIAM R. STECHER, M.D.

HODGKIN'S DISEASE

Roentgen Treatment of the So-called Malignant Lymphomas. F. W. O'Brien. Jour. Am. Med. Assn., Dec. 19, 1936, **107**, 2022–2025.

The disease entities discussed are described by their common designations—Hodgkin's disease, chronic lymphatic leukemia, and chronic myelogenous leukemia. Various attempts to classify them on a basis of stem cell or morphologic grounds and the merits of the controversy as to whether one or the other is an infectious process need not detain one. For all essential purposes, they involve radiosensitive tissues and behave like neoplastic processes, terminating almost invariably in death.

Roentgen therapy was used locally in fractional doses in the treatment of 45 cases of Hodgkin's disease, 12 cases of lymphatic leukemia and 29 cases of myelogenous leukemia over a ten-year period with symptomatic relief. Some patients enjoyed relatively good health over long periods of time, but there was no convincing evidence of prolongation of life by irradiation.

CHARLES G. SUTHERLAND, M.B. (Tor.).

Hodgkin's Disease and Deep X-ray Therapy. W. L. Watt. British Med. Jour., Oct. 10, 1936, pp. 712, 713.

Watt states that ordinary x-rays act well in Hodgkin's disease as long as the glands are localized and superficial. Cases so treated respond afterwards to deep radiations just as well as untreated cases. Deep therapy is recommended because the response to treatment is much quicker and by varying the voltage and filterage to suit the glands to be treated, one can in a short time treat masses of glands, no matter where situated. The first irradiation should usually cover all affected areas and may be spread over a period from a week to a month as necessary. Any recrudescence should be treated at the earliest possible moment. While deep therapy cannot be considered a cure of the disease, yet it unquestionably prolongs life and often restores the patient to a more or less normal, active life in a very short period of time. With regular observation and treatment when necessary, there is on the average a three-to-one hope of living from two to five years, and a one-to-three hope of living from five to twelve years, or longer.

W. A. SODEMAN, M.D.

INFLAMMATORY DISEASES

Further Studies Regarding the Heating of Pelvic Organs with Short Wave Therapy. W. Rech and W. Raab. Strahlentherapie, 1936, **57**, 623.

The authors used wave lengths of 6 and 12 meters in the treatment of pelvic inflammatory disease. The single application lasted 20 minutes; Schliephake's condenser electrodes were applied laterally. In this manner the temperature increase in the small pelvis ranged from 0.3 to 0.7 degree centigrade. The therapeutic results are explained on the basis of an increased circulation and also an increase in the metabolism of the treated tissue. The selective effect of short waves on the cells and the tissue is also considered probable.

ERNST A. POHLE, M.D., Ph.D.

THE LARYNX

Radical X-ray Treatment of Malignancy in the Larynx and Pharynx. J. H. Douglas Webster. British Jour. Radiol., December, 1936, **9**, 799–804.

The author discusses the necessary steps in the treatment of malignancy of the larynx and pharynx by the Coutard method of roentgen therapy. The first essential is a complete clinical diagnosis, including site, origin of lesion, and probable extent of invasion. To accomplish this, and to obtain the best results throughout the course of treatment, the co-operation of a laryngologist is essential. The second step consists of x-ray examination of the region of the lesion to show the following: condition of the cartilages, the soft tissues, the upper esophagus, and the cervical vertebræ. The chest should also be studied on the roentgenogram as in some cases early metastases to the lungs may be noted. The third procedure should consist of histological examination and grading according to Broders' or some similar scale. Biopsies may be made during the course of treatment rather than before therapy.

The relative value of the radium gram unit and x-ray therapy in the treatment of these cases is still undetermined. While there are definite indications for each form of therapy, the irradiated area and the depth dose will be greater with deep x-ray therapy than with the one-gram radium unit.

In employing roentgen therapy, each case is thoroughly planned at the beginning of the treatment.

This plan should include the fields to be treated, the daily dose, and the intensity in r per minute. However, in each case the daily dose and the total dose are controlled individually by the general condition and the local reaction.

The author reports two cases of malignancy treated by means of the Coutard method in which temporary success has been obtained. Beside these two cases, his series includes 23 cases of cancer of the larynx and pharynx which have been treated by Coutard's method. In 10 of the 25 cases, general or local improvement for varying periods has been noted.

The following suggestions are made by the author: (1) Preliminary gastrostomy in order to rest the affected region as much as possible; (2) irradiation of other fields to include the upper thorax.

J. N. Ané, M.D.

Further Experiences with the Desensitization of Mucous Membrane during Protracted Fractional Roentgen Therapy. R. Glauner. Strahlentherapie, 1936, **57,** 670.

In nine cases of carcinoma of the hypopharynx and larynx undergoing roentgen therapy according to the Coutard method, the author sprayed adrenalin on the mucous membrane of one side. As shown in a previous communication, this reduced the reaction of the mucous membrane to a minimum. In this new series, three patients showed no reaction at all on the sprayed side, three almost none, while two did not finish the series of treatments. One patient showed no effect of the adrenalin. This failure is explained by the fact that the patient was suffering from infection of the mouth, and the author uses this case as an example to emphasize the necessity of thorough oral hygiene before starting protracted fractional therapy.

Ernst A. Pohle, M.D., Ph.D.

THE LUNGS

Tomography and its Value in Lung Diagnosis. Kurt Greineder. München. med. Wchnschr., May 29, 1936, **83,** 892–895.

Tomography has accomplished the hitherto impossible by visualizing roentgenographically separate body layers at any chosen depth of the body, by blurring out other confusing superimposed shadows. The principle of tomography is essentially a double pendulum arrangement, with tube attached above and film holder below, which revolves about a horizontal axis, so that each describes opposite arc directions having a central angle of 45 degrees. The depth of body layer desired is accomplished by adjusting the tomograph to this level. The bronchi and great vessels are well delineated at a desired level, while foci and cavities in the lung proper, which are not detectable upon an ordinary roentgenogram, are easily shown. In the tomogram of the lung, disturbing overlying ribs and other densities are eliminated. In pulmonary tuberculosis one can readily distinguish productive, exudative, and fibrous foci. Of great importance is the determination by this method of the size, shape, character, and relation of cavities to the bronchi. Atelectatic lung regions present characteristic flat regular shadows not observed by the ordinary technic, particularly if located in marginal regions, for, on account of the thinness of the cortical lung-field, an effect of over-exposure causes loss of definition in outline.

A most important use of this method is the detection of cavities entirely obscured by thick cirrhotic tissue in chronic fibro-ulcerative tuberculosis. Tumorous infiltration and abscess formation can be differentiated. Bronchiectasis is well shown without the aid of a contrast material such as lipiodol. Foreign body localization can be readily performed with this method, and one can determine quickly whether a body is extra- or intra-thoracic.

The article is excellently illustrated, and the apparatus is shown, which should convince even the most skeptical of its value. The great progress made in this field offers much in anticipation of further refinements in technic and ultimate diagnosis.

William R. Stecher, M.D.

X-ray Therapy in Carcinoma of the Lung. J. Struthers Fulton. British Med. Jour., Oct. 3, 1936, pp. 671–673.

Fulton divides patients presenting themselves for x-ray therapy in carcinoma of the lung into three groups. One group includes those patients with disease so advanced that simpler and more effective palliation may be obtained by morphine. In the second group one finds those patients with loss of weight, indicative of metastases, or in whom the extent of the lesion is such as to preclude any hope of successful radical treatment. Here palliative irradiation is justified. This is most readily accomplished by a short course of treatment. Dosage should be carried up to the level of a mild erythema, at which level quite effective palliation may be obtained. Finally, the third group includes those cases in which radical treatment would appear to be justified. Here debility in the patient is absent and the lesion is of such limited extent that on assessment it will be possible to include it entirely within the irradiation zone.

W. A. Sodeman, M.D.

The Pseudo-syphilitic, Subacute Hilar Bronchopneumonitis of the Undernourished Child. G. Fanconi. Schweiz. med. Wchnschr., Aug. 29, 1936, **35,** 821–826.

A series of cases presenting confusing roentgenologic, clinical, and sero-diagnostic facts is analyzed, in which (1) roentgenologically, rather typical prominence of the hilar lymph nodes, with prominence of the basal trunk shadows, was compatible with bronchopneumonitis; (2) clinically, an undernourished child was observed intermittantly febrile, and suspected of childhood tuberculosis; (3) serologically, all cases presented strongly positive Wassermann reactions

and negative tests for tuberculosis. When the patients recovered without treatment, the Wassermann reactions became negative. No family history of syphilis was found in any of the cases. This entity must, henceforth, be kept in mind, and anti-specific treatment not administered in erroneously considered cases of syphilis. The author then considers the incidence of the presence of a positive Wassermann reaction and lung affections, and in reviewing the literature, finds it to be a rare combination; nonetheless, other diseases aside from syphilis may give a positive serologic reaction, and the author wishes to add this syndrome which is definitely non-tuberculous or syphilitic, as a simulant.

WILLIAM R. STECHER, M.D.

Athlete's Lung. Tiemann. München. med. Wchnschr., Sept. 11, 1936, **37,** 1517–1520.

Histologic proof is presented, demonstrating that the lungs in athletes gradually become larger, as do other viscera, showing compensatory changes. The size and weight of the lungs increase with the degree of taxation on the organ, but of greatest importance is the increase in number of alveoli.

WILLIAM R. STECHER, M.D.

PHYSIOTHERAPY

Theoretical Principles of Short Wave Therapy. F. Dessauer. Strahlentherapie, 1936, **57,** 582.

The author describes briefly the biophysical difference between the action of electrical currents passing through the human body as contrasted with short waves below 30 meters. The possibilities of a specific effect of this wave length range is considered, based on physical laws. The application of the author's etiology theory used in the explanation of the effect of x-rays and radium on cells may also be used in explaining some of the phenomena observed in short wave therapy.

ERNST A. POHLE, M.D., Ph.D.

Short Wave Therapy in Internal Medicine. E. Schliephake. Strahlentherapie, 1936, **57,** 553.

The Present Status of Short Wave Therapy. J. Kowarschik. Strahlentherapie, 1936, **57,** 593.

The Present Status of Short Wave Therapy. C. Urbach. Strahlentherapie, 1936, **57,** 600.

Schliephake, the well known pioneer in the field of short wave therapy, presents a critical analysis of its present status. While the article does not lend itself to abstracting, it is recommended for study in the original to all interested in this therapeutic agent.

In a very condensed paper Kowarschik discusses the indications and contra-indications for the use of short electric waves in medicine. He emphasizes their "selective" action, *i.e.*, the property of heating certain tissues greatly, others hardly, and independent of the ohm's resistance.

Urbach names the diseases in which ultra-short electric waves have proved of value. He has seen good results in furuncles and carbuncles, sinusitis, empyema of the pleura, lung abscess, pneumonia, periostitis, various types of arthritis, and many others. The apparatus used in his clinic is briefly described.

ERNST A. POHLE, M.D., Ph.D.

Fundamental Principles and Therapeutic Results of Therapy with "Athermic" Short Waves. P. Liebesny Strahlentherapie, 1936, **57,** 615.

The author points out that the use of short waves is not without danger, some of their biologic effects being in contrast to the effect of heat alone. The application of "athermic" short waves, *i.e.*, waves which do not produce any appreciable amount of heat on the skin surface, may have excellent therapeutic effect on inflammatory foci, either on the body surface or below.

ERNST A. POHLE, M.D., Ph.D.

THE PITUITARY BODY

Pituitary Basophilism (Cushing's Syndrome): Report of a Verified Case, with a Discussion of the Differential Diagnosis and Treatment. R. H. Freyberg, Paul S. Barker, L. H. Newburgh, and Frederick A. Coller. Arch. Int. Med., August, 1936, **58,** 187–212.

A verified case of pituitary basophilism showing the classical syndrome has been reported. Nine verified cases of pituitary basophilism showing the classical syndrome are reviewed by the authors. This review includes cases reported since Cushing's review of the literature in 1933. The authors also reviewed 14 cases of cortical adrenal lesions or neoplasms of the thymus gland showing many or all of the characteristics of pituitary basophilism.

The methods of administration of roentgen therapy and results obtained in 18 cases of pituitary basophilism are outlined. The factors of roentgen radiation employed by the different authors were as follows: kv., 185–200; ma., 5–30; filter, 0.5–0.75 mm. Cu plus 1 mm. Al; F. S. D., 40–50; time, 3.3–240 minutes; number of ports, 2–4; number of days' treatment occupied, 3–49; total r, 760–3,800. Cushing's case was treated in the following manner: 185 kv; 0.5 mm. Cu plus 1 mm. Al filter; 40–46 F. S. D.; 2-minute exposure; treatment occupied six days; total r, 1,000. One and one-half months later the series was repeated. Two months later 1,200 r were given in four days. Similar series were then repeated at intervals of three, four, eight, two, and two months, respectively. Kepler repeated his series of treatments in one month, Wright in two months, and Lawrence in three months.

Wright's case is the only one in which the diagnosis of basophilism having been verified, the condition was reported as improved after roentgen therapy. The improvement in this patient was chiefly in the state of

general well-being. The blood pressure was higher after treatment than before.

In seven of the unverified cases the results were questionable and in eleven the condition was reported as improved. In Jamin's case and in Cushing's case the results were very gratifying.

The variation in results may be due to the variation in radiosensitivity of the tumor, the age of the patient, duration of illness before radiation, and the method of radiation. In every case given a large dose (3,000 r at least), the patient improved. The authors believe that roentgen therapy should be intensively and persistently pursued.

It is difficult to differentiate between a pituitary and an adrenal involvement. Roentgenograms of the sella turcica are of no aid. The adrenal gland only occasionally presents signs such as palpable tumor or distorted pyelograms. It seems wise in cases in which the causative lesion cannot be definitely determined to treat the patient for pituitary basophilism. If no benefit results, the adrenals should be explored. The patients having pituitary basophilism are poor surgical risks, and consequently, the exploration of the adrenals should be attempted last.

E. M. Shebesta, M. D.

Basophilic Hyperpituitarism. J. F. Bromley. British Jour. Radiol., December, 1936, **9,** 818–823.

The author reports a series of seven cases of basophilic hyperpituitarism which showed improvement and some relief after roentgen therapy to the pituitary. The constant factors employed were: 200 kv. constant tension, 1.5 mm. copper plus 0.5 mm. aluminum filter, and 40 cm. anti-cathode skin distance. All doses were measured with back-scatter and calculated on to the pituitary. For the first series of treatments, the author employed from 1,500 to 2,200 r. The second series of treatments, when necessary, were somewhat smaller.

Basophilic hyperpituitarism may be recognized as a very definite syndrome, associated with involvement of the basophilic cells of the anterior lobe of the pituitary. As a general rule, the patients are rather young adults. Sexual dystrophy, in the form of amenorrhea in the female and impotence in the male, is a relatively early feature. Hypertrichosis in females and adolescent males and the reverse in adult males are noted. Adiposity, associated with a dry and coarse appearance of the skin, and the presence of dark striæ on the abdomen, are other features of this condition. Other symptoms are excessive thirst, polyuria, aching pains in the eyes, thinning of the hair of the scalp, and lumbar backache. An atrophy of bone, especially of the spine and cranial vault, are observed on roentgenograms. However, roentgenograms of the sella turcica show no enlargement. Increase in blood pressure is common. Hyperglycemia and glycosuria may occur. Mental depression and mental lassitude are also observed in some of these cases.

J. N. Ané, M.D.

PNEUMOTHORAX

Therapeutic Artificial Pneumothorax in True Pneumonia. L. Polak Daniels. Schweiz. med. Wchnschr., Dec. 12, 1936, **50,** 1260, 1261.

A brief survey of the literature of this procedure is analyzed and the author makes the following deductions from his own experience, and as shown roentgenologically. There is nothing to date to show that the hepatized lung is or can be collapsed by the pressure of the average pneumothorax. As to shortening the period of illness by producing an early crisis, this is questionable. The theory that rest of the involved lung will aid by reducing the number of bacteria and toxic products systemically has never been proven and is rather dubious. The one outstanding inducement for the employment of this procedure is that when inordinate pleuritis is a concomitant of pneumonia, the pneumothorax aids by separating the apposing pleural surfaces. Possible complications of this method are mentioned; *viz.*, herniation of the mediastinum, only avoided by roentgenologic check; also, sudden cardiac failure, and if bilateral extension occurs, lack of aeration space of the originally collapsed side.

William R. Stecher, M.D.

THE PROSTATE

Etiology of Prostatic Hypertrophy. W. Koch. München. med. Wchnschr., Sept. 11, 1936, **37,** 1501, 1502.

Prostatic hypertrophy can be artificially induced in dogs by the injection of prolan. Inasmuch as Prolan A is found in the urine of human males, presenting hypertrophy of the prostate, the inference is drawn that the etiologic factor well may be hyperfunction of the anterior lobe of the hypophysis. It is intimated that proper therapeusis must accordingly be directed additionally to the pituitary dysfunction, and parenthetically, whether in the nature of hormonel therapy or radiation.

William R. Stecher, M.D.

PRURITUS VULVÆ

Roentgen Therapy of Pruritus Vulvæ. Walter Wobker. München. med. Wchnschr., July 31, 1936, **31,** 1275, 1276.

Stress is placed upon the etiology of the symptom pruritus vulvæ, particularly the frequent association of diabetes with this symptom. When no definite factor can be demonstrated the term "essential pruritus" is applied. The itching is often extremely annoying in this condition and may become intolerable. Of 30 females treated with radiation, 18 were in the climacteric, and one had been castrated. This is a significant association; namely, ovarian deficiency and

pruritus vulvæ. The technic was as follows: S.T.D. 70 cm.; 0.5 mm. Cu; 200 kv.; 6 ma.; 15 min.; 80 per cent E.S.D. or 640 r. This was repeated in two weeks, if no amelioration was present, and very resistant cases were again radiated in eight weeks. In most cases the effect was almost immediate, but occasionally delayed results occurred, even to the extent of four months. Of these patients, eight were completely cured, 15 greatly improved, and seven unaffected, which succinctly is a betterment of three-fourths of the cases by radiotherapeusis.

WILLIAM R. STECHER, M.D.

RADIUM

An Investigation of Internal Radon Therapy. F. D. Howitt, E. C. Pillman-Williams, and S. Russ. British Med. Jour., Jan. 30, 1937, pp. 208–213.

This investigation was carried out to determine the physiological or biochemical changes induced by comparatively small doses of radon, to assess any possible value of such treatment upon various diseases, and to use larger dosages to find when they become dangerous. It is pointed out that the introduction of radon into the body presents a totally different problem from that of radio-active salts. An apparatus is described for the preparation of radon water, which was drunk by the patients in doses varying from one-thirtieth of a millicurie to four millicuries. Various conditions, including gout, chronic rheumatism, and hyperpiesia were treated.

In patients receiving the smaller doses no demonstrable change was found in the clinical condition. Blood counts were not affected and no injurious results were encountered. In those to whom radon was given in larger doses no improvement was noted in the clinical condition except in certain cases of chronic gout. Chemical analyses of the blood were unaffected, with the exception of the uric acid readings in the latter group. The erythrocyte count showed a tendency to fall when large doses were employed, in certain instances to a serious degree, so that such doses are attended by a definite risk, and should be administered with great caution.

W. A. SODEMAN, M.D.

Experiences with Radium Therapy of Hemangioma. H. Aretz. Strahlentherapie, 1936, **57**, 682.

The author describes his technic in the treatment of hemangioma by radium. He uses applicators at contact filtered through 0.2 mm. Ag + 1 mm. brass and applies from 4 to 8 mg.-hr. per square centimeter in order to avoid an erythema. This dose may be repeated after one month and then according to the response of the lesion. The total dose rarely exceeds from 20 to 30 mg.-hr. per square centimeter and reaches from 60 to 70 mg.-hr. per square centimeter only in very resistant lesions over a two-year period. Of 11 cases with nevus flammeus treated, only two responded well. An analysis of these cases leads the author to the conclusion that this type of angioma should not be treated with radium. Eighty-six cases with cavernous hemangioma were also treated, of which 52 were cured, 18 considerably improved, six improved, five had unsatisfactory results, while five developed slight degrees of late reactions.

ERNST A. POHLE, M.D., Ph.D.

ROENTGEN KYMOGRAPHY

Roentgen Kymographic Examination of the Diaphragm Following Phrenico-exeresis. M. A. Sisti and F. Soricelli. Archivio di Radiologia, March–April, 1936, 108–113.

The authors report a series of 16 cases studied by the method of G. Torelli from two to five months after operation. They feel that roentgen kymography is a valuable method of study for it detects a certain number of operative failures or the return of nerve function which cannot be discovered by any other diagnostic procedure.

E. T. LEDDY, M.D.

THE STOMACH

Etiology of Carcinoma of the Stomach. M. Hindhede. München. med. Wchnschr., May 22, 1936, **83**, 852–854.

The author makes the following statements: "Man is the only mammal who dies of carcinoma of the stomach. Among uncivilized people, who exist on a predominate vegetable diet, carcinoma of the gastro-intestinal tract is almost unknown. Thus, in India there is an incidence of 4 per cent as compared to 60 per cent in Denmark of all carcinomas arising from the stomach." This he considers due to the over-nourishing diet, for in no country are there so many obese individuals as in Denmark. Since a campaign for a vegetable diet has been waged, the morbidity has markedly diminished. He concludes that irritation from food, particularly spoiled meat, excessive use of salt and condiments, strong beer, brandy, and tobacco are cardinal factors in producing malignancy of the gastro-intestinal tract.

WILLIAM R. STECHER, M.D.